EVALUATION OF DISPOSITION SCORES IN *BOS INDICUS/BOS TAURUS* CROSS CALVES AT DIFFERENT STAGES OF PRODUCTION

A Thesis

by

RENA REBECCA FUNKHOUSER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2008

Major Subject: Animal Breeding

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Approved by:

Chair of Committee,	James O. Sanders
Committee Members,	Clare Gill
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ABSTRACT

Evaluation of Disposition Scores in *Bos indicus/Bos taurus* Cross Calves at Different Stages of Production. (August 2008)

Rena Rebecca Funkhouser, B.S., Virginia Tech

Chair of Advisory Committee: Dr. Jim Sanders

Aggressiveness, nervousness, flightiness, gregariousness and overall disposition were evaluated in F_2 Nellore-Angus embryo transfer calves (n = 443) from 13 full sib families and in half *Bos indicus*, half *Bos taurus* natural service calves (n = 259) from 4 paternal half sib families. Calves were born from 2003 to 2007, and evaluated shortly after weaning. Steers were evaluated shortly before slaughter for all 5 disposition traits and at slaughter for overall disposition. Heifers were evaluated for overall disposition at calving every year. Scores ranged from 1 to 9, with 1 being docile and 9 being unruly, except at calving where scores ranged from 1 to 5. Between sires for overall disposition, calves by 297J were lowest at weaning (2.83), before slaughter (2.84), and at slaughter (2.45) and second lowest in first calf heifers (2.27). Calves by 437J were highest at weaning (4.10), before slaughter (3.54), at slaughter (2.89) and in first calf heifers (3.10). Bulls had the lowest scores at weaning (2.54), although the number was small (n=10); females were the highest (4.01), and steers were intermediate (3.70). All 5 weaning traits were correlated ($P < 0.05$) with each other (0.73 to 0.96). The correlation of recipient disposition and weaning disposition of the calves was 0.12 ($P < 0.05$). Aggressiveness was not significantly correlated with other component traits before

slaughter but was with overall disposition (0.19, $P < 0.05$). All other traits were significantly inter-correlated (0.60 to 0.97). Disposition at weaning was correlated with disposition before slaughter (0.43, $P < 0.05$). Slaughter disposition was correlated with weaning disposition (0.30, $P < 0.001$) and disposition before slaughter (0.27, $P < 0.001$). Disposition in first calf heifers was correlated with weaning disposition (0.34, $P < 0.001$) and disposition in second calf females (0.53, $P < 0.0001$). The results indicate that both genetics and recipient disposition affect calf disposition at weaning, calves with better dispositions at weaning have better dispositions later in life, and there is sufficient variability within and between these full sib and half sib families for use in QTL analysis for major genes for disposition in Nellore-Angus cross cattle.

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INTRODUCTION

Disposition can most generally be defined as the nature of an animal and its effect on the way it behaves towards humans (Gauly et al., 2001). It can be measured in many different ways, both objectively through methods such as flight times and subjectively through the assignation of a numerical score based on observation. The disposition, or temperament, of cattle has an impact on many different aspects of the beef industry. It not only affects the ease with which animals can be handled and the safety of the workers (Grandin, 1993), but has also been shown to have an effect on growth (Fell et al., 1999; Gauly et al., 2001; Petherick et al., 2002; Voisinet et al., 1997b), carcass (Fordyce et al., 1985; Fordyce et al., 1988b; Voisinet et al., 1997a), tenderness (Kadel et al., 2006; King et al., 2006; Voisinet et al., 1997a) and milk production (Breuer et al., 2000; Hemsworth et al., 2000) traits as well. In addition, those animals with excitable (less desirable) disposition tend to become stressed more easily and therefore can have an increased susceptibility to disease, especially in feedlot situations (Fell et al., 1999). It is important for the beef industry to acknowledge and capitalize on these differences, especially because consumers are becoming more aware and discerning about the quality of their food and the handling and care of the animals.

This thesis follows the style of Journal of Animal Science.

LITERATURE REVIEW

Breed Differences

Major differences in disposition have been observed between breeds of cattle. An early review by Cartwright (1980) examined differences in Zebu cattle as compared to European cattle. Variations in both temperament and intelligence were noted between these 2 types of cattle. Temperament was a concern in Brahman cattle, as Brahman were noted for their response to human contact, as well as their athletic ability. Burrow (1997) reviewed numerous papers on different measurements of temperament and the relationship between temperament and performance. Results from one study showed that animals with ¼ or ½ Brahman influence had poorer temperaments than do their British cross counterparts. Another study concluded that Brahman cattle had longer flight distances than British cattle, indicating more fear of humans. A third study showed that Brahman crosses had poorer temperaments than Africander crosses which in turn had poorer temperaments than British crosses. Additionally, 2 other studies concluded that Sahiwal influenced cattle had poorer temperaments than either Brahman or Africander influenced cattle. Moreover, a report from Australian Meat Research Committee (AMRC) showed that animals with 75% *Bos indicus* had higher flight distances and speed scores in a small enclosed area than animals with 50% *Bos indicus*. It was concluded that *Bos indicus*, specifically Brahman and Brahman cross, which are predominant in the southern United States due to their increased levels of heterosis and their heat and parasite resistance, and Nellore and Nellore crosses, have unambiguously worse temperaments than *Bos taurus* breeds such as Hereford and Angus.

Burrow and Corbet (2000) evaluated genetic and environmental effects on temperament in Australia. Differences in genotype (breed composition) were evaluated by breeding Brahman cows to Brahman, Angus, Hereford, Shorthorn, Charolais, Limousin, Santa Gertrudis or Belmont Red bulls. Temperament was evaluated on all calves from these matings; it was measured in 3 ways. First, a flight score was taken. For this, the time (in seconds) that it took an animal to run a certain distance after being released from a squeeze chute was measured electronically with higher times indicating better temperaments. Second, an observer determined a visual flight score. The observer scored each calf on a scale of 1 to 5 as a visual appraisal of how quickly the calves left the chute with lowers scores indicating better temperaments. Finally, a crush score was also given. An observer scored animals again on a scale of 1 to 5, with 1 being very calm in the squeeze chute and 5 being uncontrollable. Sire breed was found to have a significant effect on all 3 measures of temperament. However, the rankings of the breeds were unpredictable, although calves sired by Limousin bulls had both the lowest flight speed and the highest crush scores, indicating that these calves had the least desirable temperaments. As a result, Burrow and Corbet (2000) suggested that Continental breeds such as Charolais and Limousin have a negative combining ability with Brahmans or at the very least their temperament is no better than *Bos indicus* cattle. However, Prayaga (2003) who also evaluated cattle in Australia for several adaptive and temperament traits, disagreed with this conclusion. In this study cattle comprised of tropically adapted British breeds, Sanga derived breeds, Continental breeds (Charolais and Simmental), Zebu breeds and Zebu cross breeds were evaluated. Temperament was

measured by an objective flight score, much like the electronic flight score in Burrow and Corbet (2000), and again, breed composition was found to have a significant effect, but there was no clear trend for different breeds.

Hearnshaw and Morris (1984) evaluated calves for genetic and environmental effects on temperament in New South Wales and found that there was a difference between *Bos indicus*- and *Bos taurus*-sired calves. In this study Hereford cows were bred to Hereford, Simmental, Fresian, Brahman, Braford and Africander bulls. Temperament was determined by a crush score. An observer assigned scores from 0 to 5 while the calf was confined in a squeeze chute, with 0 being calm and 5 being wild. In group one where calves were sired by Hereford, Simmental, Fresian or Brahman bulls, the Brahman-sired calves had significantly higher scores (1.96) than the other 3 sire breeds combined (1.05). In addition, the percentage of Brahman in the calves had an impact on temperament as well. The differences between temperament scores of 100% *Bos taurus* calves and 50% *Bos indicus* calves was 0.91 (1.96 vs 1.05), while the difference between 100% *Bos taurus* calves and 25% *Bos indicus* calves was 0.45 (1.97 vs 1.41).

A study by Fordyce (1988a) evaluated bullocks and cows in 2 different experiments in Australia to determine what affects temperament. Breeds involved in this study were Shorthorn or Brahman x Shorthorn. Temperaments were evaluated for all cattle with movement scores and speed scores. For movement scores an observer assigned scores from 1 to 7 for cattle as they stood unrestrained in a chute, with 1 being calm and 7 showing a great deal of movement. For speed scores, cattle were assigned a

value from 1 to 5 with 1 moving very quickly out of the chute and 5 moving slowly. Bullocks were also scored with a crush test and a respiration test. For the crush test, they were scored on a scale of 1 to 5 with 1 showing very little movement while restrained in a squeeze chute and 5 showing a great deal of movement; for the respiration test, they were scored on a scale of 1 to 4 where 1 indicated very calm breathing and 4 indicated very agitated breathing. For all measures of temperament Brahman crosses were higher (had worse temperaments) than the Shorthorns, although movement was not significantly different in bullocks.

Voisinet et al. (1997a) conducted a study to evaluate cattle for factors affecting tenderness and the incidence of dark cutters. Braford, Red Brangus and Simbrah steers and heifers were transported from Florida to Colorado for use in this study. These cattle ranged from 25 to 50% Brahman. Temperament was evaluated by scoring calves from 1 to 4 depending on behavior when they were restrained in a squeeze chute based on a scale established by Grandin (1993). It was concluded that there were no significant differences in temperament between the breeds, but Red Brangus had the poorest temperament (2.18), followed by Braford (1.99); Simbrah were the calmest (1.14).

In a study used to determine the effect of temperament on average daily gain by Voisinet et al (1997b), the same 3 breeds of *Bos indicus* cross cattle from Florida were used in addition to Simmental x Red Angus, Angus, and Tarentaise x Angus. The Simmental x Red Angus cattle came from Nebraska and the Angus and Tarentaise x Angus from Wyoming. These cattle were split into 2 groups, Brahman crosses and *Bos taurus*. Temperament was evaluated in 2 different ways by 2 independent observers.

The first observer scored both *Bos indicus* cross steers and heifers and *Bos taurus* steers (because there were no heifers in the *Bos taurus* groups of cattle) on a 1 to 5 scale similar to Grandin (1993) in a non-restrained crate. The second observer scored only *Bos indicus* cattle on a scale of 1 to 4 in a hydraulic squeeze chute. Temperament scores varied between breeds groups for the first observer with *Bos indicus* crosses having poorer temperaments (3.46) than *Bos taurus* crosses (1.80). Voisinet et al (1997b) did express some concern that at least some of the difference might have been due to the differences in geographical origin of the different types of cattle. The second observer did not observe any significant differences in the different breeds of *Bos indicus* crosses in the squeeze chute, although the Simbrah cattle were calmer than the other Brahman crosses.

Sex Differences

In early work, Tulloh (1961) evaluated temperaments of Hereford, Shorthorn and Angus steers and heifers. Temperament was evaluated with 4 different scores; while entering the scales, while entering the crush, while entering the headgate and when standing in the headgate. For entering the scales and the crush, cattle were scored on a scale of 1 to 4, where a score of 1 was for animals that entered without hesitation and animals with a score of 4 were very difficult to get into the scale or crush. For entering the headgate, animals were also scored on a scale of 1 to 4, with animals that put their head in without encouragement receiving a 1 and animals which resisted strenuously and for a long time receiving a 4. Finally, while animals were standing in the headgate, they were scored on a scale of 1 to 6 with 1 being docile and 6 being aggressive. Differences

between the temperaments of heifers and steers were not significant for any of the tests; however, results did indicate that steers had better temperaments than heifers.

Gauly et al. (2001) evaluated Angus and Simmental cattle for genetic variability in temperament traits. Temperament was evaluated by a non-restraint and a restraint test. In the non-restraint test, an evaluator attempted to separate an animal from the group for a specified amount of time. The time separated was noted and any attempts to return to the group were also recorded. In the restraint test, an animal was put in a small pen with an evaluator who attempted to restrain the animal in the corner for a set amount of time. Again, the time separated was noted and any attempts to move out of the corner were recorded. A score of 1 to 5 was also assigned for the restraint test during the second year. Heifers had longer separation times and spent more time running. In addition, heifers also attempted to return to the group more, indicating that heifers were more difficult to handle.

The studies by Burrow and Corbet (2000) and Hearnshaw and Morris (1984), which evaluated the effect of breed on temperament, also assessed the effect of gender on temperament. Burrow and Corbet (2000) found no difference between steers and heifers for flight scores or visual flight scores, but found that heifers had higher crush scores (2.33) than did steers (2.24). Hearnshaw and Morris (1984) also found no significant difference between steers and heifers in 3 different data sets. Conversely, the studies by Voisinet et al. (1997a) and Voisinet et al. (1997b), discussed in the breed differences section, did find a significant difference in the temperaments of steers and heifers. Both of these studies concluded that heifers had poorer dispositions (were more

excitable) than steers. Voisinet et al. (1997a) reported least squares means of 2.23 for heifers and 1.98 for steers, and Voisinet et al. (1997b) reported least squares means of 3.72 for heifers versus 3.39 for steers. Voisinet et al. (1997b) also suggested that sex differences may be observable only in certain breeds, specifically those breeds which have poorer temperaments to begin with, such as *Bos indicus* derived breeds.

Burrow (1997) compared several different studies, which evaluated the effect of gender on temperament and surmised that there are no solid conclusions about this effect. Several studies were cited where steers had better temperaments than heifers (Tulloh, 1961 and Stricklin et al., 1980 as cited by Burrow, 1997), bulls had better temperaments than heifers (Shrode and Hammack, 1971), and bulls had better temperaments than steers (Vanderwert et al., 1985); however, several other studies were cited where there were no differences between genders (Hinch and Lynch, 1987; Hearnshaw et al., 1979 as cited by Burrow, 1997; and Tilbrook et al., 1989).

Effects of Temperament on Growth

Several studies have been conducted to evaluate the effect of temperament on growth traits. In most studies, it was concluded that temperament does have an effect on growth; however, the authors of a few disagree, or at least are not sure of the relationship between growth and temperament. Burrow (2001) evaluated the relationship between production and adaptive traits and temperament in an extensive management system. For this study temperament was determined by flight scores (in seconds). The genetic and phenotypic correlations between temperament and several different measures of growth were close to zero, indicating that in extensive management systems

temperament is a fairly independent trait. Prayaga and Henshall (2005) agreed with this conclusion. In this study, production, adaptive and temperament traits were also evaluated, and again temperament was determined by flight scores. In addition, Fordyce et al. (1996) reached the same conclusion. In this study temperament was determined by a combination of tests including a movement score, respiration score and crush score. There were no significant relationships between temperament and any growth traits to 24 mo. These 3 studies all evaluated cattle with some *Bos indicus* influence, but Müller and von Keyerlingk (2006) evaluated flight score and average daily gain in *Bos taurus*, specifically Angus, heifers. In this study, temperament was determined by an average of 4 flight scores taken at different intervals. These results indicated that the relationship between flight score and temperament is quadratic rather than linear as many other studies have shown, with slower and faster animals having lower average daily gains than those animals with average flight scores; and therefore Müller and von Keyerlingk (2006) concluded that the relationship between flight scores and average daily gain is not clear.

In an earlier study by Fordyce et al. (1985), temperament and bruising in *Bos indicus* steers were evaluated. Temperament was evaluated by several different scores added together for an overall temperament score. These scores included a crush test, movement test, and respiration test. Animals were then split into 3 groups: nervous group with a temperament score greater than 2, docile group with a temperament score less than 2, and a mixed group. Temperament was significantly negatively correlated

with live weight; the docile group (480 kg) and mixed group (467 kg) being significantly heavier than the nervous group (440 kg).

Burrow and Dillon (1997) evaluated the relationship between temperament and gain and carcass characteristics in *Bos indicus* cross feedlot steers and heifers. Two cohorts were used, one in 1989 and the other in 1990. The 1989 cohort received minimal handling prior to entering the feedlot, while the 1990 cohort was subjected to an intensive period of handling before being sent to the feedlot. In both cohorts, temperament was measured objectively using flight speeds to classify the animals into either good or poor temperaments (slow or fast flight scores, respectively). They concluded that animals with slow flight scores (i.e. good temperaments) tended to grow faster in feedlots regardless of whether the slower flight speeds were a result of handling or because the animals were naturally more calm. The relationship between temperament and average daily gain, final weight and carcass weight was significant for the 1989 cohort but not for the 1990 cohort, although there was a trend between poorer temperaments and lower average daily gains in the 1990 cohort. It was speculated that this may be due to those animals with better temperaments having an increased feed intake, but they did not discount the possibility that animals with faster flight scores also expend more energy on “nervous” behavior.

Fell et al. (1999) found that steers with nervous behavior also showed changes in immune function, which increases susceptibility to disease. As a result, 42% of the steers in the nervous group in this study had to be put in the hospital pen during their time in the feedlot as compared to the calm group in which none of the steers required

time in the hospital pen. In this study, the association between temperament, performance and immune function was evaluated in steers in a commercial feedlot. Hereford or Hereford x Angus steers, representing the extremes in temperament, were selected for use in this study. The 12 animals with the fastest flight scores, and moderately high crush scores, were chosen for the nervous group. The 12 animals with the slowest flight scores, moderately low crush scores and the most confidence, measured as the willingness to eat in the presence of a human, were chosen for the calm group. The nervous group had lower average daily gains than the calm group for the first 37 d (0.95 kg/d vs. 1.46 kg/d) and after 78 days (1.04 kg/d vs. 1.46 kg/d). The overall weight gain of the calm group did not differ from the mean of the cohorts from which they were selected, while the nervous group's overall weight gain was lower than the mean of their cohorts.

Petherick et al. (2002) evaluated productivity and carcass and meat quality in *Bos indicus* cross steers grouped according to temperament, determined by flight score. The flight score of an animal was taken 3 times, and the average score was used to place steers into 3 groups: good temperament (flight scores from 0.8 to1.69 m/s), mixed temperament (flight scores from 0.86 to 3.7 m/s) and poor temperaments (flight scores 1.89 to 4.41 m/s). The difference between poor and good temperament groups was significant for live weight for the entire feeding period and for body condition score. The 3 groups did not differ in weight or body condition score when entering the study, but the mean final live weight and body condition score for the good temperament group was 612.7 kg and 7.48 respectively versus 591.9 kg and 7.13 for the poor temperament

group. Average daily gain also tended to be lower for the poor temperament group as compared to the good temperament group (1.37 kg/d versus 1.54 kg/d) although this difference was not significant.

Gauly et al. (2001), who estimated variability in temperament traits in Angus and Simmental cattle, also found that less docile animals tended to be less productive. In this study, temperament was evaluated through both a restraint and non-restraint test, as described in the sex difference section. The conclusion was that there was a negative correlation between average daily gain and temperament.

Voisinet et al. (1997b) evaluated *Bos taurus* and *Bos indicus* cross steers and heifers for temperament and average daily gain. Temperament was evaluated by 2 different observers as discussed in the breed differences section. For both experiments temperament was a significant source of variation in average daily gain. In experiment 1 as average daily gain increased, temperament score decreased (i.e. temperament was better), with the exception of temperament score 1 *Bos indicus* calves. It should be noted that there were a very small number (n = 4) of *Bos indicus* temperament score 1 calves, which may account for the low average daily gain of that group. In experiment 2 the relationship between average daily gain and temperament was the same; as temperament score increased, average daily gain decreased.

There is both a genetic and phenotypic correlation between temperament and average daily gain according to Nkrumah et al. (2007). In this study, genetic and phenotypic relationships between feeding behaviors, temperament, performance and carcass characteristics were evaluated. Angus, Charolais and University of Alberta

Hybrid bulls were bred to 3 different synthetic breeds of dam. Two of these dam breeds were strictly beef breeds, and the third was 60% dairy. Temperament was evaluated objectively with a flight score, which was found to be phenotypically negatively correlated with both dry matter intake and average daily gain. In addition, there was a weak genetic correlation (-0.25) between temperament (flight score) and average daily gain.

Burrow (1997) reviewed the results of 4 different studies in which the relationship between live weight and temperament was evaluated. In three of these studies, a consistent relationship between temperament and weight was found, with heavier animals having better temperaments. The fourth study, (O'Roarke, 1989 as cited by Burrow, 1997) found that correlations were positive until 6 mo, zero at 12 mo, and negative at 24 mo. Therefore, those calves with lighter weights had better temperaments scores at a younger age, but those animals with heavier weights had better temperament scores at 2 years of age. However, it was noted that maternal and direct effects were not separated in this study and there were large standard errors, which may account for this discrepancy.

Effects of Temperament on Carcass Characteristics

The effect of temperament on different carcass characteristics and meat quality has been evaluated in several different studies. Burrow (1997) reported that while several studies have shown that pre-slaughter stressors have a significant impact on different carcass and meat quality characteristics, there is less information on individual animals' susceptibility to stress, the relationship of susceptibility to temperament, and

that effect on carcass and meat quality traits. This is in agreement with the varying levels of relationship between temperament and carcass or meat quality characteristics in the following studies. Both Burrow and Dillon (1997) and Petherick et al. (2002) found that temperament was significantly negatively correlated with dressing percent. Therefore, those animals with better temperaments (i.e. lower temperament scores) had more desirable dressing percentages.

Burrow and Dillon (1997) also found that flight speed (temperament) was not associated with the presence of bruising on the carcasses, which agrees with Fordyce et al. (1985). However, Fordyce et al. (1988b), who also analyzed the effect of temperament on carcass traits as well as on meat quality for Shorthorn and Brahman Shorthorn cross bullocks and cows, found different results. Fordyce et al. (1988b) used a more subjective crush score and yard score to determine temperament and found that those animals with higher (less desirable) temperate scores actually did have significantly more bruise trim per carcass. The bruising was predominantly in or adjacent to the higher priced cuts of meat. It was suggested that these discrepancies may be due, at least in part, to the fact that animals with poor temperaments tend to bruise not only themselves but also the calmer animals in the pen with them, which could lead to the conclusion that temperament does not have an effect on carcass bruising.

Furthermore, Fordyce et al. (1988b) found that cattle with poorer temperaments also tended to have higher shear force values, indicating that the meat from these carcasses was tougher and less palatable. This finding agrees with the results of studies by Kadel et al. (2006), King et al. (2006) and Voisinet et al. (1997a) who also found that

temperament significantly affected shear force values and tenderness of the meat. Kadel et al. (2006) used flight times and crush scores to evaluate temperament in a group of Brahman, Brahman cross, and tropically adapted *Bos taurus* cattle in Australia. Temperament was genetically correlated with tenderness, and it was determined that slower flight times (better temperaments) were correlated with improvements in tenderness as measured by both Meat Standards of Australia and shear force on *M. longissiums thoracis et lumborum*. King et al. (2006) also used a measure of flight time, chute score (similar to Grandin (1993)), and approach score to determine temperament and agreed with the finding that animals with better temperaments have more tender carcasses later in the aging process, as measured by Warner-Bratzler shear force values. It was suggested the temperament was related to stress response which in turn was related to conditions that were less favorable for calpain mediated proteolysis. Proteolysis has a greater impact on tenderness as a carcass is aged. However, King et al. (2006) found that temperament did not affect factors determining quality grade, specifically incidence of dark cutters. While Voisinet et al (1997a), who evaluated *Bos indicus* cross steers and heifers for temperament by a single observation of crush score, also found that temperament affects tenderness, they also found that a high proportion of carcasses that were borderline dark cutters were from excitable animals (animals with temperament scores of 4 had a mean 25% dark lean).

Nkrumah et al. (2007), who evaluated genetic and phenotypic relationships between temperament and carcass characteristics, found that flight score had a strong positive phenotypic relationship to carcass loin muscle area and carcass lean meat yield

(i.e. those with more desirable temperaments (lower scores) had smaller ribeyes and lower yields) and a negative phenotypic relationship with carcass grade fat (fat measured at the 12th to 13th rib) (-0.25), marbling score (-0.22) and yield grade (-0.25). In addition, moderate to high negative genetic correlations were found for temperament with carcass grade fat (-0.11 ± 0.27) and yield grade (-0.22 ± 0.27) and positive genetic correlations were found for carcass loin muscle area (0.32 ± 0.25), lean meat yield (0.33 ± 0.23) and marbling score (0.10 ± 0.28).

Effects of Temperament on Milk Production

Most studies for evaluating the effects of temperament on milk production have been done with *Bos taurus* dairy type cattle, although Burrow (1997) discussed 2 studies in which milk yield of *Bos indicus* cows was evaluated. It was reported that those cows with poorer temperaments had poorer milk yields and also had shorter lactation periods.

In 2 studies (Breuer et al., 1999 and Hemsworth et al., 2000) conducted in Australia, the relationship between temperament, as it relates to fear of humans, and milk production and yield was evaluated. Both studies were conducted on commercial dairy farms that met certain criteria. Cows were all predominantly Holstein-Fresian, grazed outside on pasture and milked twice a day (morning and afternoon). Farms were selected based on the availability of production records such as milk yield, milk protein, and milk fat; herd size; had a herringbone milking parlor; and fed supplement to the cows during milking. Hemsworth et al. (2000) chose farms with herds of 150-350 cows. The response of cows to humans was tested with an approach test. Cows were selected at random after morning and afternoon milkings. These cows were individually

introduced to an arena and given 2 minutes to adjust. After 2 minutes an observer entered the arena with a stool and sat motionless. The cow's approach was then observed for the next 3 minutes. The area 1, 2, 3, and 4 yards away from the observer was marked and the time it took for the cow to reach a 1 and 3 yard distance was recorded. Also, the amount of time spent within 1 and 3 yards was also noted. Flight distance was then determined by approaching the cow and noting how close the observer could get before she moved. In this study, the percent of time a cow spent within one meter of the observer and the flight distance were negatively correlated with milk yield, milk protein and milk fat; the time it took for a cow to get within one meter of the observer was positively correlated with milk yield, milk protein, and milk fat (i.e., cows that spent more time within one meter of the observer had lower milk yield, milk protein, and milk fat, but cows that took less time to get within one meter of the observer had higher milk yields, protein, and fat); however, none of these correlations were significant. Breuer et al. (2000) used commercial dairy farms with a herd size of 100 to 200. Temperament was evaluated with an approach test much like Hemsworth et al. (2000). For Breuer et al. (2000), the average time a cow spent within 3 meters of the observer was significant and positively correlated with milk yield, milk fat and milk protein, indicating that calmer cows had higher milk yields, protein and fat. Both studies concluded that poor temperament may limit the productivity of dairy cattle. In fact, the approach test accounted for 19% of the variability in milk yield in cows (Breuer et al., 2000).

OBJECTIVES

The objective of this study was to evaluate several aspects of disposition (temperament) in *Bos indicus*/ British crossbred cattle at different stages of production. Secondarily, recipient scores were evaluated to determine if the disposition of the recipient cow has an effect on the disposition of the embryo transfer calf. The results of this study will be used to locate genes with major effects on disposition.

MATERIALS AND METHODS

Description of Data

Data collected from *Bos indicus* x British cross cattle born at the Texas A&M Research Center at McGregor were evaluated for several disposition scores. Beginning in 2002, embryo transfer (ET) full sib families of F_2 Nellore/Angus calves were produced using 4 F_1 Nellore/Angus bulls and 10 F_1 Nellore/Angus donor cows. These families were created to evaluate several different traits including temperament, and to look for genes related to those traits. The goal was to create 10 ET families with at least 20 heifers per family. Because of poor embryo production, some of the donor dams were replaced, giving a total of 13 ET families (Table 1). In addition to these ET families, 4 natural service half sib families have also been established for use in the same study. The same F_1 Nellore/Angus bulls were mated to F_1 and F_2 Brahman/Hereford and Brahman/Angus dams to produce these half sib families (Table 2). These natural service calves were produced in multiple-sire pastures, and required DNA testing to determine paternity. All procedures involving animals were approved by the Texas A&M Institutional Animal Care and Use Committee; AUP # 2002-116 and 2005-147.

All calves were scored for disposition shortly after weaning. Steers were then evaluated again at about 18 mo of age, both in feeding pens a few weeks before slaughter, and once more at slaughter. Females are scored each year at calving time.

At weaning calves were evaluated for aggressiveness, nervousness, flightiness, gregariousness and overall disposition by 4 evaluators. Overall disposition was an assessment of overall temperament and not an average of the other traits. For each trait,

the evaluators assigned scores independently. Scores range from 1 to 9 for all traits with 1 being completely docile and 9 being wild or crazy. Calves were gate cut into groups of approximately 15 and placed in separate holding pens. Two calves were then cut out of the holding pen and into an alley that is approximately 25 meters long, with 2 evaluators standing at either end. The calves were given a chance to settle down and then one was cut back into the holding pen. The remaining calf was evaluated, and then turned into a separate pen. During scoring most calves ran up and down the alley. If a calf tried to hit an evaluator, it was given a high (undesirable) aggressiveness score. Nervousness and flightiness measured similar aspects of disposition. However, those animals that have high (undesirable) flightiness scores tend to run up and down the alley more and attempt to escape while those with a high (undesirable) nervousness score may exhibit other forms of nervousness such as shaking or frequent urination. Gregariousness was a measure of how willing an animal was to be separated from the group. Those animals that attempted to return to the other animals were given a high (undesirable) gregariousness score.

Table 1. Sire, dam and total number of offspring, bulls, heifers, and steers of ET families

Family	Sire	Dam	Offspring	Bulls	Heifers	Steers
70	297J	431H	33	0	15	18
71	297J	760H	63	2	29	32
72	432H	511G	45	1	20	24
73	432H	732H	8	0	2	6
74	437J	640H	8	0	4	4
75	437J	728H	36	1	19	16
76	551G	664J	7	0	2	5
77	551G	787G	41	1	17	23
80	551G	429H	66	1	23	42
81	437J	636H	57	1	19	37
82	432H	559J	15	1	6	8
83	437J	637H	35	1	19	15
84	551G	911H	29	1	14	14

Steers scored prior to slaughter were evaluated on the same scale for the same 5 traits, but by a single evaluator. The evaluator entered each of the feeding pens and observed the steers. Under these conditions, the steers that were afraid of the evaluator ran to the outer edge of the pen and did not usually get close to the evaluator. Therefore, those steers with high (undesirable) aggressiveness scores tended to be tame steers that approached the evaluator and may have licked, followed and/or tried to hit him. Nervousness and aggressiveness were measured much the same as in the weaned calves. For gregariousness, the evaluator attempted to separate each steer from the others in the pen, and a score was assigned based on the success of that attempt. Again, overall disposition was an assessment of overall temperament and not an average of the other traits. At slaughter, steers were again assigned an overall disposition score from 1 to 9. This score was determined mainly by the steers' behavior in the chute immediately prior to harvest, unless behavior in the holding pen warranted attention.

Females are scored every year at calving using a scale of 1 to 5 where 1 is docile and 5 is wild or aggressive. Recipient cows used to produce the embryo transfer calves were scored in the same manner every year at calving as well.

Table 2. Sire and total number of offspring, bulls, heifers, and steers of natural service families

Family	Sire	Offspring	Bulls	Heifers	Steers
95	297J	68	0	28	40
96	432H	120	0	61	59
97	437J	56	0	18	38
98	551G	15	0	7	8

Statistical Analyses

Weaning, yearling, slaughter and female disposition scores were evaluated using the MIXED procedure of SAS (2003). Scores for all 5 traits were evaluated in weaned calves and yearling steers. Analyses were run with ET calves alone, and with ET and NS calves together. Fixed effects for weaned calves included sire, family within sire, birth year and season, sex, pen within birth year and season, and evaluator within birth year and season. Based on the results of previous analyses, a sex by sire interaction was also included in the model. Continuous effects included recipient disposition within birth year and season and evaluation sequence within pen within birth year and season. The weaned calves were evaluated both with recipient scores as an independent variable and without. Overall disposition at weaning was also evaluated without evaluation sequence within pen within birth year season in the model, because of the concern that sequence can be affected by disposition. Sires ranked the same in the models with and

without sequence and ranking of families was similar. Least squares means from the model without sequence are presented by sire and family in Appendix tables A-1 and A-2, respectively. Residuals were found for all calves, these residuals are presented in Appendix B and the standard deviations of the residuals are presented in Appendix C. The correlation between recipient disposition and overall score at weaning was also evaluated. Fixed effects in the analyses of yearling steer disposition scores included sire, family within sire, birth year and season, and feeding pen within birth year and season. The model was run with and without overall weaning score as a continuous variable. The model was also run with and without recipient disposition score as a continuous variable. The model for steers at slaughter was the same as the yearling scores, with the addition of slaughter order within slaughter date within birth year and season as a fixed effect. The model was originally run with feed pen included, but this was removed for the final analysis because it was not significant. The model was also run with and without number of knocks required at slaughter included, and knocks was evaluated as a discrete variable and then as a continuous variable. For this study, the number of knocks was the number of times an animal had to be struck with a captive bolt gun before being immobile enough to be exsanguinated. Simple correlations between overall weaning score and overall yearling score; overall weaning score and slaughter score; overall yearling score and slaughter score; and slaughter score and number of knocks were evaluated. First calf heifer disposition was evaluated with a model that included sire, family within sire, cow birth year and season, and calving year and season within birth year and season. Again the model was run with and without recipient disposition within

birth year and season and Julian calving date within calving year and season as continuous variables. The simple correlation between cows as 2 yr olds (first calving) and 3 yr olds was also evaluated. Significance values for the models are included in Appendix D.

RESULTS AND DISCUSSION

Weaned Calves

Least squares means for aggressiveness, nervousness, flightiness and gregariousness at weaning, by sire, for ET calves are presented in Table 3 (with bull calves included), and least squares means for overall disposition at weaning, by sire, for ET calves, with and without bull calves, are presented in Table 4. With bull calves included, the sires ranked the same across all 5 traits, although all sires had lower numerical scores for aggressiveness than for any other trait. Aggressiveness means ranged from 1.88 to 2.92 for sires. Nervousness ranged from 2.97 to 4.01, flightiness from 2.63 to 4.03, and gregariousness from 2.60 to 4.02. For all traits, sire 297J was the lowest (most desirable) with an overall disposition of 2.61 and 437J was the highest with an overall disposition of 3.88. Sires 432H and 551G were intermediate for all traits. When bulls were removed, sire 297J was still the lowest with an overall disposition of 2.62, and 437J was still the highest with an overall disposition of 4.48. However, without bull calves, 551G was the second lowest, and 432H was the second highest, although the difference was not significant.

Table 3. Least squares means and standard errors (SE) for 4 component traits at weaning by sire for ET calves (n = 517)

Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
297J	1.88 ± 0.23	2.97 ± 0.25	2.63 ± 0.25	2.60 ± 0.25
432H	1.96 ± 0.39	3.24 ± 0.30	3.06 ± 0.31	3.04 ± 0.30
551G	2.57 ± 0.21	3.66 ± 0.22	3.54 ± 0.23	3.43 ± 0.22
437J	2.92 ± 0.21	4.01 ± 0.22	4.03 ± 0.23	4.02 ± 0.22

Table 4. Least squares means and standard errors (SE) for overall disposition at weaning by sire for ET calves

Sire	Overall Disposition[g] ± SE	Overall Disposition[h] ± SE
297J	2.61[a] ± 0.25	2.62[d] ± 0.12
432H	2.83[a,b] ± 0.30	3.87[e] ± 0.17
551G	3.38[b,c] ± 0.22	3.58[e] ± 0.13
437J	3.88[c] ± 0.22	4.48[f] ± 0.13

Means with no superscript in common differ ($P < 0.05$)
[g]Bulls included (n = 517)
[h]Bulls excluded (n = 507)

Least squares means for the 4 component disposition traits at weaning by family for ET calves are presented in Table 5. The families are ranked in ascending order according to their aggressiveness score. In general, the rankings across aggressiveness, nervousness, flightiness, and gregariousness remained fairly consistent, with only minor re-ranking among families for these 4 traits. For aggressiveness, least squares means ranged from 1.64 to 4.20, for nervousness 2.60 to 4.97, flightiness 2.33 to 4.95, gregariousness 2.31 to 5.07, and overall disposition ranged from 2.29 to 4.97. Family 71, sired by 297J, was the lowest (most desirable) for all four component disposition traits; while family 74, sired by 437J, was the highest. Least squares means for overall disposition at weaning by family for ET calves are presented in Table 6. For overall disposition, Family 71 was again the lowest (most desirable), and Families 81 and 74, both sired by 437J, were the highest.

Table 5. Least squares means and standard errors (SE) for 4 component traits at weaning by family for ET calves

Family	Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
71	297J	1.64 ± 0.24	2.60 ± 0.25	2.33 ± 0.26	2.31 ± 0.25
76	551G	1.74 ± 0.37	2.67 ± 0.39	2.59 ± 0.40	2.53 ± 0.39
73	432H	1.81 ± 0.41	3.14 ± 0.43	3.06 ± 0.44	2.84 ± 0.43
72	437J	1.85 ± 0.29	3.14 ± 0.31	3.00 ± 0.32	3.03 ± 0.31
83	437J	1.98 ± 0.24	2.92 ± 0.25	2.94 ± 0.26	2.81 ± 0.25
70	297J	2.13 ± 0.27	3.33 ± 0.28	2.92 ± 0.29	2.90 ± 0.28
80	551G	2.22 ± 0.22	3.72 ± 0.23	3.58 ± 0.24	3.50 ± 0.23
75	437J	2.23 ± 0.24	3.75 ± 0.25	3.78 ± 0.26	3.97 ± 0.25
82	432H	2.23 ± 0.33	3.43 ± 0.35	3.12 ± 0.36	3.25 ± 0.35
84	551G	2.94 ± 0.24	4.22 ± 0.25	4.10 ±0.26	4.01 ± 0.25
81	437J	3.26 ± 0.23	4.41 ± 0.24	4.47 ± 0.25	4.24 ± 0.24
77	551G	3.37 ± 0.24	4.02 ± 0.25	3.87 ± 0.26	3.70 ± 0.25
74	437J	4.20 ± 0.37	4.97 ± 0.39	4.95 ± 0.40	5.07 ± 0.39

Table 6. Least squares means and standard errors (SE) for overall disposition at weaning by family for ET calves

Family	Number of calves	Sire	Overall Disposition ± SE
71	63	297J	2.29^{a} ± 0.25
76	7	551G	$2.44^{a,b}$ ± 0.39
72	45	432H	$2.73^{a,c}$ ± 0.31
83	35	437J	$2.80^{a,d}$ ± 0.25
73	8	432H	$2.85^{a,e}$ ± 0.43
82	15	432H	$2.93^{a,f}$ ± 0.35
70	33	297J	$2.93^{b,c,d,e,f}$ ± 0.28
80	66	551G	$3.33^{c,d,e,f}$ ± 0.23
75	36	437J	$3.48^{e,f,g}$ ± 0.25
77	41	551G	$3.85^{g,h}$ ± 0.25
84	29	551G	$3.90^{g,i}$ ± 0.25
81	57	437J	$4.27^{h,i}$ ± 0.24
74	8	437J	4.97^{j} ± 0.38

Means with no superscripts in common differ ($P < 0.05$)

Table 7 and Table 8 present the least squares means by gender for the 4 component traits and for overall disposition at weaning in ET calves, respectively. For all 5 measures of disposition, bulls were the lowest (most desirable), steers were intermediate, and heifers were the highest. However, it is important to note that there

were only 10 bulls included in the study; 2 sired by 297J, 2 sired by 432H, 3 sired by 551G, and 3 sired by 437J. In addition, the 10 bulls were only in 2 of the 11 contemporary groups; 9 were in the spring 2006 calf crop and one was in the fall 2006 calf crop. Although there was no strong selection pressure placed on disposition for those animals kept as bulls, if there were 2 animals that were equal for all other traits, the calmer one was most likely the one kept, which may have had an influence on the low scores for bulls.

Table 7. Least squares means and standard errors (SE) for 4 component traits at weaning by gender for ET calves

Gender	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
Bull	1.59 ± 0.32	2.43 ± 0.34	2.44 ± 0.35	2.48 ± 0.34
Steer	2.51 ± 0.09	3.81 ± 0.10	3.55 ± 0.10	3.50 ± 0.10
Heifer	2.90 ± 0.10	4.17 ± 0.11	3.95 ± 0.11	3.84 ± 0.11

Table 8. Least squares means and standard errors (SE) for overall disposition at weaning by gender for ET calves

Gender	Overall Disposition ± SE
Bull	2.25^{a} ± 0.34
Steer	3.40^{b} ± 0.10
Heifer	3.87^{c} ± 0.11

Means with no superscripts in common differ ($P < 0.05$)

In addition, there was a significant gender by sire interaction. The 2 bulls sired by 432H had a much lower disposition score (more desirable) than their steer and heifer counterparts, and they also had a lower overall disposition than bulls by the other 3 sires.

The 3 bulls sired by 437J were also much lower than their steer and heifer mates, although the difference was not as large. There was little difference between genders for 551G and 297J, with heifers sired by 551G having a slightly higher overall disposition than their bull and steer half siblings. These results are presented graphically in Figure 1.

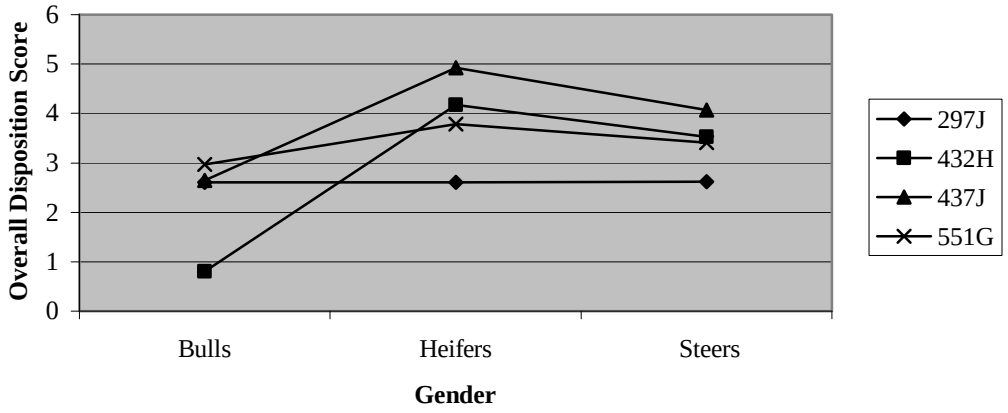

Figure 1. Gender by sire interaction for overall disposition at weaning for ET calves.

Least squares means for both ET and natural service calves for the 4 component disposition traits at weaning (including bull calves) and for overall disposition at weaning, with and without bulls, are presented in Table 9 and Table 10, respectively. When bull calves were included, the sires ranked the same for all calves, as they did for ET calves only, across all measures of disposition. Least squares means for aggressiveness within sires ranged from 2.05 to 3.09, for nervousness from 3.16 to 4.26, for flightiness from 2.85 to 4.18 and for gregariousness from 2.77 to 4.01. Sire 297J was the lowest (most desirable) for all 5 disposition traits with an overall disposition of 2.83,

and 437J was the highest with an overall disposition of 4.10. With bulls included, 432H ranks second lowest and 551G third lowest. Again, without bulls, these 2 intermediate sires reversed, and 551G became the second lowest, followed by 432H. With both ET and natural calves, the difference between these 2 sires without bulls was significant (note that none of the natural calves were bulls).

Table 9. Least squares means and standard errors (SE) for 4 component traits at weaning by sire for all calves (n = 702)

Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
297J	2.05 ± 0.23	3.16 ± 0.24	2.85 ± 0.25	2.77 ± 0.24
432H	2.17 ± 0.24	3.40 ± 0.25	3.08 ± 0.26	3.08 ± 0.25
551G	2.93 ± 0.19	4.07 ± 0.20	3.89 ± 0.20	3.74 ± 0.20
437J	3.09 ± 0.19	4.26 ± 0.20	4.18 ± 0.21	4.01 ± 0.20

Table 10. Least squares means and standard errors (SE) for overall disposition at weaning by sire for all calves

Sire	Overall Disposition[h] ± SE	Overall Disposition[i] ± SE
297J	2.83^{a} ± 0.24	3.03^{d} ± 0.09
432H	$2.96^{a,b}$ ± 0.26	4.08^{e} ± 0.12
551G	$3.78^{b,c}$ ± 0.20	3.71^{f} ± 0.11
437J	4.10^{c} ± 0.20	4.65^{g} ± 0.10

Means with no superscript in common differ ($P < 0.05$)
[h]Bulls included (n = 702)
[i]Bulls excluded (n = 692)

Least squares means by family for ET and natural service calves combined are presented in Table 11 and Table 12. In Table 11, the families are again ranked in ascending order by their aggressiveness score. In general, the order of ET families remained constant when the natural service calves are added as compared to ET calves

alone. Aggressiveness within families ranged from 1.63 to 4.47, nervousness from 2.61 to 5.06, flightiness from 2.32 to 4.94, gregariousness from 2.33 to 4.87, and overall disposition from 2.30 to 5.04. Family 71, sired by 297 J was still the lowest across all disposition traits with an overall disposition of 2.30. Similarly, families 81 and 74, sired by 437J, were still the highest across all disposition traits with overall dispositions of 4.57 and 5.04 respectively, and were significantly higher than any other families for overall disposition.

Table 11. Least squares means and standard errors (SE) for 4 component traits at weaning by family for all calves

Family	Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
71	297J	1.63 ± 0.23	2.61 ± 0.25	2.32 ± 0.25	2.33 ± 0.24
73	432H	1.82 ± 0.40	3.24 ± 0.42	2.95 ± 0.43	2.83 ± 0.41
76	551G	2.10 ± 0.38	3.23 ± 0.39	3.04 ± 0.41	2.92 ± 0.39
70	297J	2.13 ± 0.27	3.37 ± 0.28	2.97 ± 0.29	2.94 ± 0.28
96	432H	2.14 ± 0.26	3.17 ± 0.27	2.85 ± 0.28	2.75 ± 0.27
72	432H	2.18 ± 0.26	3.39 ± 0.27	3.14 ± 0.28	3.18 ± 0.27
83	437J	2.26 ± 0.22	3.28 ± 0.23	3.19 ± 0.24	3.00 ± 0.23
95	297J	2.40 ± 0.25	3.50 ± 0.26	3.27 ± 0.27	3.03 ± 0.26
75	437J	2.43 ± 0.22	4.10 ± 0.23	3.98 ± 0.24	3.99 ± 0.23
82	432H	2.54 ± 0.30	3.78 ± 0.32	3.39 ± 0.33	3.56 ± 0.31
80	551G	2.71 ± 0.20	4.24 ± 0.21	4.07 ± 0.22	3.90 ± 0.21
97	437J	2.78 ± 0.22	4.11 ± 0.23	4.11 ± 0.24	3.83 ± 0.23
84	551G	3.04 ± 0.23	4.44 ± 0.24	4.28 ± 0.24	4.12 ± 0.23
77	551G	3.35 ± 0.22	4.19 ± 0.23	4.00 ± 0.23	3.79 ± 0.22
98	551G	3.46 ± 0.29	4.24 ± 0.30	4.03 ± 0.31	3.99 ± 0.30
81	437J	3.50 ± 0.21	4.75 ± 0.22	4.71 ± 0.22	4.39 ± 0.21
74	437J	4.47 ± 0.37	5.06 ± 0.38	4.94 ± 0.39	4.87 ± 0.38

Table 12. Least squares means and standard errors (SE) for overall disposition at weaning by family for all calves

Family	Sire	Overall Disposition ± SE
71	297J	$2.30^{a} \pm 0.25$
96	432H	$2.74^{a,b} \pm 0.27$
73	432H	$2.84^{a,c,e} \pm 0.42$
76	551G	$2.94^{a,d,e} \pm 0.39$
72	432H	$2.98^{a,f} \pm 0.27$
70	297J	$2.99^{b,c,d,f} \pm 0.28$
83	437J	$3.16^{b,c,d,f} \pm 0.23$
95	297J	$3.21^{b,c,d,e,f} \pm 0.26$
82	432H	$3.29^{b,c,d,f,g} \pm 0.32$
75	437J	$3.74^{e,g,h} \pm 0.23$
80	551G	$3.86^{g,j} \pm 0.21$
77	551G	$3.96^{g,k,l,m} \pm 0.23$
97	437J	$3.99^{g,k,n} \pm 0.23$
98	551G	$4.02^{g,m,o} \pm 0.30$
84	551G	$4.09^{h,j,l,n,o} \pm 0.24$
81	437J	$4.57^{o,p} \pm 0.22$
74	437J	$5.04^{p} \pm 0.38$

Means with no superscripts in common differ ($P < 0.05$)

Least squares means by gender for ET and natural service calves combined at weaning were also analyzed and the results are presented in Table 13 and Table 14. Again, bulls were significantly lower than steers or heifers with an overall disposition of 2.54, and steers (3.70) were significantly lower than heifers (4.01) for all 5 traits. However, it should be noted that there are still only 10 bulls in the study, and all are ET calves.

Table 13. Least squares means and standard errors (SE) for 4 component traits at weaning by gender for all calves

Gender	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
Bull	1.90 ± 0.30	2.76 ± 0.31	2.65 ± 0.32	2.63 ± 0.31
Steer	2.77 ± 0.07	4.03 ± 0.07	3.77 ± 0.07	3.68 ± 0.07
Heifer	3.01 ± 0.07	4.36 ± 0.07	4.09 ± 0.08	3.90 ± 0.07

Table 14. Least squares means and standard errors (SE) for overall disposition at weaning by gender for all calves

Gender	Overall Disposition ± SE
Bull	$2.54^{a} \pm 0.31$
Steer	$3.70^{b} \pm 0.07$
Heifer	$4.01^{c} \pm 0.07$

Means with no superscripts in common differ ($P < 0.05$)

Again, there was a significant gender by sire interaction. As in the analysis of ET calves, the 2 bulls sired by 432H had a much lower overall disposition than their steer or heifer counterparts and were the lowest of all gender by sire groups in the study. In addition, the 3 bulls sired by 437J were also much lower than their steer and heifer counterparts; although the difference was not as drastic as the one for calves sired by 432H. For sire 551G, bulls were slightly higher than steers, which were slightly higher than heifers; while for sire 297J, bulls were slightly lower than steers or heifers, and steers were slightly higher than heifers. These results are presented graphically in Figure 2.

Figure 2. Gender by sire interaction for overall disposition at weaning for all calves.

Simple correlations between all 5 disposition traits for ET calves averaged across evaluators at weaning and the correlation of recipient disposition with overall disposition at weaning are presented in Table 15. For these correlations, the average of all 4 evaluators' scores, for each of the 5 disposition traits, was used to calculate the correlations. All 4 component traits were highly positively correlated with each other and with overall disposition (range from 0.823 to 0.985, $P < 0.001$). Nervousness and flightiness were the most highly correlated with overall disposition (0.985 and 0.983, respectively), and were also highly correlated with each other (0.980). Aggressiveness had the lowest correlation with overall disposition (0.904). Recipient disposition had a low, but significantly positive simple correlation of 0.116 with overall disposition ($P < 0.05$).

Table 15. Simple correlations between 5 disposition trait averages[a] and recipient disposition for ET calves at weaning

	Nervousness	Flightiness	Gregariousness	Overall Disposition
Aggressiveness	0.869 < 0.001	0.865 < 0.001	0.823 < 0.001	0.904 < 0.001
Nervousness		0.980 < 0.001	0.955 < 0.001	0.985 < 0.001
Flightiness			0.957 < 0.001	0.983 < 0.001
Gregariousness				0.960 < 0.0001
Recipient Disposition				0.116 < 0.05

[a] Average of scores from all evaluators

The simple correlations for all 5 disposition traits and recipient disposition for ET calves at weaning when all 4 evaluators' scores are included are presented in Table 16. These results showed the same trend as those when the evaluator scores are averaged for a single score per calf, but were consistently lower. Nervousness and flightiness were still the most highly correlated with overall disposition, with correlations of 0.960 and 0.955, respectively ($P < 0.001$). Nervousness and flightiness were also highly correlated with each other (0.944, $P < 0.001$). Aggressiveness still had the lowest correlation with overall disposition (0.841, $P < 0.001$). In addition, recipient disposition still had a low, but significant correlation with overall disposition (0.096, $P < 0.001$).

Table 16. Simple correlations between 5 disposition traits and recipient disposition with evaluators[a] for ET calves at weaning

	Nervousness	Flightiness	Gregariousness	Overall Disposition
Aggressiveness	0.802 < 0.001	0.780 < 0.001	0.748 < 0.001	0.841 < 0.001
Nervousness		0.944 < 0.001	0.874 < 0.001	0.960 < 0.001
Flightiness			0.870 < 0.001	0.955 < 0.001
Gregariousness				0.888 < 0.001
Recipient Disposition				0.096 < 0.001

[a] Each evaluators' score included separately

Simple correlations between the 5 disposition traits averages for ET and natural service calves at weaning are presented in Table 17. Again, for these correlations, the 5 traits scores from all 4 evaluators were averaged to give one score for each calf. As for the ET calves, all 5 disposition traits were highly positively correlated. Aggressiveness had the lowest correlation with overall disposition at 0.899 ($P < 0.001$). Once more, nervousness and flightiness were the most highly correlated with overall disposition, with correlations of 0.984 and 0.983, respectively ($P < 0.001$). Nervousness and flightiness were also the most highly correlated among the four component traits (0.9780).

The simple correlations between the 5 disposition traits for all evaluators for both ET and natural service calves at weaning are presented in Table 18. Again, for these correlations all 4 evaluators' scores are included separately in the analysis. The results were similar, but again, the correlations were numerically lower when all 4 evaluators' scores are included separately.

Table 17. Simple correlations between 5 disposition trait averages[a] for all calves at weaning

	Nervousness	Flightiness	Gregariousness	Overall Disposition
Aggressiveness	0.865 < 0.001	0.863 < 0.001	0.814 < 0.001	0.899 < 0.001
Nervousness		0.980 < 0.001	0.953 < 0.001	0.984 < 0.001
Flightiness			0.954 < 0.001	0.983 < 0.001
Gregariousness				0.959 < 0.001

[a] Average of scores from all evaluators

Table 18. Simple correlations between 5 disposition traits with evaluators[a] for all calves at weaning

	Nervousness	Flightiness	Gregariousness	Overall Disposition
Aggressiveness	0.792 < 0.001	0.770 < 0.001	0.734 < 0.001	0.829 < 0.001
Nervousness		0.940 < 0.001	0.865 < 0.001	0.957 < 0.001
Flightiness			0.860 < 0.001	0.955 < 0.001
Gregariousness				0.880 < 0.001

[a] Each evaluators' score included separately

Feedlot and Pre-Slaughter Disposition in Steers

Least squares means and standard errors for the 4 component traits for ET steers shortly before slaughter are presented by sire in Table 19, and for overall disposition by sire in Table 20. Sires were ranked in ascending order according to nervousness score in Table 19 and according to overall disposition in Table 20. These scores were assigned by a single evaluator in feed pens approximately 2 wk before slaughter. For nervousness and flightiness, family and sire were significant. Only family was significant for overall disposition, gregariousness, and aggressiveness shortly before slaughter. Rankings were similar to those for weaned calves. Least squares means ranged from 1.03 to 1.36 for aggressiveness, 2.81 to 4.16 for nervousness, 2.78 to 4.00 for flightiness, and 2.09 to 2.86 for gregariousness. Sire 297J was the lowest (most desirable) for all component traits except for aggressiveness and was also the lowest for overall disposition (2.77). Sire 432H was the lowest for aggressiveness; however, he was the highest for all other

component traits and for overall disposition (3.79). Sires 437J and 551G were intermediate for all traits, with 437J being the second highest for all component traits and for overall disposition (3.57), and 551G being second lowest for all component traits and for overall disposition (3.32). The difference between 297J and 437J and 432H was significant for overall disposition; no other differences were significant.

Table 19. Least squares means and standard errors (SE) for 4 component traits shortly before slaughter[a] by sire for ET calves (n = 204)

Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
297J	1.17 ± 0.13	2.81 ± 0.28	2.78 ± 1.28	2.09 ± 0.23
551G	1.36 ± 0.12	3.30 ± 0.25	3.27 ± 0.25	2.30 ± 0.21
437J	1.15 ± 0.13	3.85 ± 0.29	3.86 ± 0.29	2.81 ± 0.24
432H	1.03 ± 0.16	4.16 ± 0.35	4.00 ± 0.35	2.86 ± 0.29

[a] Scored in feed pens by single evaluator

Table 20. Least squares means and standard errors (SE) for overall disposition shortly before slaughter[a] by sire for ET calves (n = 204)

Sire	Overall Disposition ± SE
297J	2.77^{b} ± 0.25
551G	$3.32^{b,c}$ ± 0.22
437J	3.57^{c} ± 0.26
432H	3.79^{c} ± 0.31

[a] Scored in feed pens by single evaluator
Means with no superscripts in common differ ($P < 0.05$)

Least squares means and standard errors for all 4 component traits for ET steers shortly before slaughter by family are presented in Table 21 and for overall disposition by family in Table 22. Families were ranked by nervousness score for the 4 component traits, and by overall disposition for Table 22. In general, families that had low

aggressiveness scores ranked high for the other component traits and overall disposition, and families that ranked high for aggressiveness had lower scores for all other component traits and overall disposition. Because aggressiveness was evaluated as an animal's willingness to approach, and desire to hit, the evaluator, the reverse ranking of families for aggressiveness, as compared to the other disposition traits, may be due to that fact that calmer steers are more willing to approach the evaluator. This willingness to approach may not be due to defensiveness, but because these steers are tamer, and, therefore, more comfortable around humans and want to play. Aggressiveness least squares means ranged from 0.85 to 2.35, nervousness from 2.19 to 5.83, flightiness from 2.14 to 6.08, gregariousness from 1.45 to 4.97, and overall disposition from 2.12 to 4.99. Family 71, sired by 297J, was the lowest for nervousness, flightiness and overall disposition and is the 2nd lowest for gregariousness. Family 71 was significantly lower than families 81 and 74 (sired by 437J), 70 (also sired by 297J), 84 and 80 (sired by 551G) and 72 and 73 (sired by 432H). Families 74, sired by 437J, and 73, sired by 432H, were the highest for nervousness, flightiness and overall disposition (4.99 and 4.35 respectively). Family 74 was also the highest for gregariousness.

Table 21. Least squares means and standard errors (SE) for 4 component traits shortly before slaughter[a] by family for ET calves

Family	Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
71	297J	1.20 ± 0.16	2.19 ± 0.36	2.14 ± 0.36	1.53 ± 0.30
76	551G	2.35 ± 0.32	2.33 ± 0.71	2.18 ± 0.70	1.45 ± 0.59
83	437J	1.58 ± 0.26	2.56 ± 0.57	2.60 ± 0.56	1.58 ± 0.47
77	551G	0.85 ± 0.18	3.07 ± 0.40	3.05 ± 0.40	2.34 ± 0.34
75	437J	0.98 ± 0.22	3.30 ± 0.48	3.17 ± 0.47	2.37 ± 0.40
70	297J	1.14 ± 0.20	3.43 ± 0.44	3.41 ± 0.44	2.65 ± 0.37
81	437J	1.12 ± 0.16	3.72 ± 0.35	3.60 ± 0.34	2.31 ± 0.29
80	551G	1.16 ± 0.17	3.84 ± 0.37	3.88 ± 0.36	2.48 ± 0.31
82	432H	1.15 ± 0.32	3.93 ± 0.71	3.46 ± 0.70	2.48 ± 0.59
84	551G	1.08 ± 0.23	3.96 ± 0.51	3.97 ± 0.51	2.94 ± 0.43
72	432H	1.08 ± 0.17	4.19 ± 0.38	4.17 ± 0.38	3.18 ± 0.32
73	432H	0.86 ± 0.32	4.35 ± 0.69	4.36 ± 0.69	2.92 ± 0.58
74	437J	0.92 ± 0.40	5.83 ± 0.89	6.08 ± 0.88	4.97 ± 0.74

[a] Scored in feed pens by single evaluator

Table 22. Least squares means and standard errors (SE) for overall disposition shortly before slaughter[a] by family for ET calves

Family	Number of steers	Sire	Overall Disposition ± SE
71	22	297J	2.12^{b} ± 0.32
77	22	551G	$2.84^{b,d}$ ± 0.36
83	11	437J	$2.85^{b,e}$ ± 0.50
76	5	551G	$3.08^{b,e}$ ± 0.62
75	14	437J	$3.12^{b,e}$ ± 0.42
82	6	432H	$3.16^{b,e}$ ± 0.62
81	31	437J	$3.30^{c,d,e}$ ± 0.31
70	17	297J	$3.41^{c,d,e}$ ± 0.39
84	12	551G	$3.55^{c,d,e}$ ± 0.45
80	33	551G	$3.79^{c,d,e}$ ± 0.32
72	22	432H	$3.85^{c,d,e}$ ± 0.34
73	5	432H	$4.35^{c,e}$ ± 0.61
74	4	437J	$4.99^{c,d}$ ± 0.78

[a] Scored in feed pens by single evaluator
Means with no superscripts in common differ ($P < 0.05$)

Tables 23 and 24 present the least squares means and standard errors for ET and natural service steers by sire shortly before slaughter for the 4 component traits and overall disposition, respectively. Again, family was significant for aggressiveness, nervousness, flightiness, gregariousness and overall disposition. In addition, sire, birth

year and season, and feed pen were significant for nervousness and flightiness, and birth year and season was significant for gregariousness and overall disposition. In addition, sire was significant for overall disposition. The model was also run with overall weaning disposition as a continuous variable, and overall weaning disposition had a significant effect on overall disposition shortly before slaughter for both ET calves and for all calves; those regression coefficients were 0.29 and 0.27, respectively ($P < 0.001$). Least squares means within sires ranged from 1.04 to 1.30 for aggressiveness, 2.87 to 3.89 for nervousness, 2.83 to 3.92 for flightiness, and 2.17 to 2.84 for gregariousness. Sire 297J was still the lowest (most desirable) for all component traits except aggressiveness and was the lowest for overall disposition, with a least squares mean for overall disposition of 2.84. Sire 437J was the highest (worst) for all component traits except aggressiveness and the highest for overall disposition (3.54). Sire 551G was the second lowest for all traits except aggressiveness with an overall disposition least squares mean of 3.41, and 432H was the second highest with an overall disposition of 3.51. The only significant difference for overall disposition was for 297J (the lowest) and all other sires.

Table 23. Least squares means and standard errors (SE) for 4 component traits shortly before slaughter[a] by sire for all calves (n = 298)

Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
297J	1.24 ± 0.08	2.87 ± 0.18	2.83 ± 0.18	2.17 ± 0.16
551G	1.30 ± 0.09	3.52 ± 0.19	3.54 ± 0.19	2.45 ± 0.18
432H	1.04 ± 0.10	3.83 ± 0.22	3.74 ± 0.22	2.62 ± 0.20
437J	1.07 ± 0.09	3.89 ± 0.20	3.92 ± 0.20	2.84 ± 0.18

[a] Scored in feed pens by single evaluator

Table 24. Least squares means and standard errors (SE) for overall disposition shortly before slaughter[a] by sire for all calves (n = 298)

Sire	Overall Disposition ± SE
297J	2.84[b] ± 0.16
551G	3.41[c] ± 0.18
432H	3.51[c] ± 0.20
437J	3.54[c] ± 0.18

[a] Scored in feed pens by single evaluator
Means with no superscripts in common differ ($P < 0.05$)

Least squares means and standard errors for ET and natural service steers shortly before slaughter for all 4 component traits by family are presented in Table 25, and for overall disposition by family in Table 26. Families in Table 25 were ranked by nervousness scores, while families in Table 26 were ranked by overall disposition. As for ET steers only, aggressiveness shows a reverse ranking from the other 3 component traits. Aggressiveness ranged from 0.83 to 2.28 within families, nervousness from 2.20 to 5.60, flightiness from 2.09 to 5.84, gregariousness from 1.37 to 4.67, and overall disposition from 2.26 to 4.75. Not including aggressiveness, family 76, sired by 551G, was the lowest for the component traits, although it should be noted that there are only 5 steers in this family, and families 74, sired by 437J, was the highest for all component traits, although it should be noted that there are only 8 steers in this family. For overall disposition, family 71, sired by 297J, was still the lowest with an overall disposition of 2.69, while family 74, sired by 437J, was the highest (4.75).

Table 25. Least squares means and standard errors (SE) for 4 component traits shortly before slaughter[a] by family for all calves

Family	Sire	Aggressiveness ± SE	Nervousness ± SE	Flightiness ± SE	Gregariousness ± SE
76	551G	2.28 ± 0.28	2.20 ± 0.60	2.09 ± 0.60	1.37 ± 0.54
71	297J	1.20 ± 0.14	2.26 ± 0.29	2.24 ± 0.29	1.75 ± 0.26
83	437J	1.42 ± 0.20	2.79 ± 0.43	2.79 ± 0.42	1.69 ± 0.39
95	297J	1.35 ± 0.13	2.96 ± 0.28	2.87 ± 0.28	2.16 ± 0.26
96	432H	1.10 ± 0.11	3.23 ± 0.24	3.22 ± 0.24	2.30 ± 0.22
77	551G	0.91 ± 0.14	3.25 ± 0.30	3.24 ± 0.30	2.24 ± 0.28
70	297J	1.16 ± 0.17	3.39 ± 0.36	3.37 ± 0.36	2.59 ± 0.33
75	437J	1.04 ± 0.17	3.45 ± 0.35	3.38 ± 0.35	2.48 ± 0.32
81	437J	1.09 ± 0.12	3.77 ± 0.26	3.72 ± 0.26	2.46 ± 0.23
97	437J	0.87 ± 0.15	3.87 ± 0.31	3.88 ± 0.31	2.91 ± 0.28
82	432H	1.13 ± 0.26	3.90 ± 0.56	3.48 ± 0.56	2.42 ± 0.51
80	551G	1.13 ± 0.14	3.92 ± 0.29	3.93 ± 0.29	2.61 ± 0.26
72	432H	1.09 ± 0.14	3.94 ± 0.29	3.90 ± 0.29	2.90 ± 0.26
98	551G	1.06 ± 0.25	4.06 ± 0.53	4.30 ± 0.53	3.00 ± 0.48
84	551G	1.10 ± 0.19	4.16 ± 0.41	4.12 ± 0.41	3.03 ± 0.37
73	432H	0.83 ± 0.28	4.27 ± 0.59	4.36 ± 0.59	2.86 ± 0.54
74	437J	0.96 ± 0.34	5.60 ± 0.73	5.84 ± 0.73	4.67 ± 0.66

[a] Scored in feed pens by single evaluator

Table 26. Least squares means and standard errors (SE) for overall disposition shortly before slaughter[a] by family for all calves

Family	Number of steers	Sire	Overall Disposition ± SE
71	22	297J	2.26^{b} ± 0.26
76	5	551G	2.84^{b} ± 0.55
95	25	297J	$2.86^{b,d}$ ± 0.26
83	11	437J	2.87^{b} ± 0.39
96	40	432H	2.99^{c} ± 0.22
77	22	551G	3.02^{b} ± 0.28
82	6	432H	3.18^{b} ± 0.51
75	14	437J	$3.31^{c,d,e}$ ± 0.32
81	31	437J	$3.33^{c,d,e}$ ± 0.23
70	17	297J	$3.40^{c,d,e,f}$ ± 0.33
97	22	437J	$3.43^{c,d,e,f}$ ± 0.28
72	22	432H	$3.62^{c,e,f}$ ± 0.26
98	7	551G	$3.64^{c,d,e,f}$ ± 0.48
84	12	551G	$3.76^{c,e,f}$ ± 0.37
80	33	551G	$3.79^{e,f}$ ± 0.26
73	5	432H	$4.24^{e,f}$ ± 0.54
74	4	437J	4.75^{f} ± 0.66

[a] Scored in feed pens by single evaluator

Means with no superscripts in common differ ($P < 0.05$)

Simple correlations between overall weaning disposition and overall disposition shortly before slaughter for ET steers alone and for all steers are presented in Table 27. Overall weaning disposition was moderately positively correlated with overall disposition shortly before slaughter for both ET steers (0.409) and all steers (0.430), $P < 0.001$.

Simple correlations between the 4 disposition traits and overall disposition shortly before weaning for ET steers are presented in Table 28, and for all steers in Table 29. Aggressiveness was negatively, but not significantly, correlated to nervousness and gregariousness for ET steers and for all steers, and also negatively but not significantly correlated to flightiness for all steers. Aggressiveness was also positively but not significantly correlated to flightiness for ET steers. It was lowly correlated with overall disposition for ET steers (0.183) and all steers (0.193), $P < 0.05$. All other traits were moderately to highly correlated with each other, and with overall disposition (0.593 to 0.973, $P < 0.001$). Nervousness and flightiness were closely associated, with a correlation of 0.973 for ET steers and 0.972 for all steers. Of the 4 component traits, flightiness was the most closely associated with overall disposition (0.908 for all steers, $P < 0.001$) and nervousness next, with a correlation of 0.901 ($P < 0.001$) for all steers.

Table 27. Simple correlations between overall disposition at weaning and overall disposition shortly before slaughter[a].

	Overall Disposition shortly before slaughter [b]	Overall Disposition shortly before slaughter [c]
Weaning Overall Disposition	0.409	0.430
	< 0.001	< 0.001

[a] Scored in feed pens by single evaluator
[b] Overall Disposition shortly before slaughter for ET calves only
[c] Overall Disposition shortly before slaughter for all calves

Table 28. Simple correlations between 5 disposition traits for ET calves shortly before slaughter[a].

	Nervousness	Flightiness	Gregariousness	Overall
Aggressiveness	-0.009	0.017	-0.078	0.183
	0.901	0.806	0.268	0.009
Nervousness		0.973	0.603	0.906
		< 0.001	< 0.001	< 0.001
Flightiness			0.607	0.925
			< 0.001	< 0.001
Gregariousness				0.593
				< 0.001

[a] Scored in feed pens by single evaluator

Table 29. Simple correlations between 5 disposition traits for all calves shortly before slaughter[a].

	Nervousness	Flightiness	Gregariousness	Overall
Aggressiveness	-0.024	-0.027	-0.092	0.193
	0.679	0.646	0.111	0.001
Nervousness		0.972	0.627	0.901
		< 0.001	< 0.001	< 0.001
Flightiness			0.633	0.908
			< 0.001	< 0.001
Gregariousness				0.601
				< 0.001

[a] Scored in feed pens by single evaluator

Nicholson (2008) found simple correlations between Warner-Bratzler shear force (WBSF) values and disposition traits at weaning, shortly before slaughter and at

slaughter for steers through Spring 2007 (n = 239) in this study. For this, carcasses were split at slaughter and the right sides of the carcasses were electrically stimulated while the left sides were not electrically stimulated. The correlations between WBSF in the electrically stimulated side of the carcasses and all 5 disposition traits at weaning ranged from 0.07 to 0.10, although none of the correlations were significant. There was also no significant correlation between aggressiveness shortly before slaughter and WBSF in either the electrically or non-electrically stimulated sides of the carcasses. However, there was a significant correlation between WBSF in the electrically stimulated sides of the carcasses and nervousness (0.16), flightiness (0.16), gregariousness (0.24), overall disposition (0.14) shortly before slaughter, and overall disposition at slaughter (0.14). In addition, there was a significant correlation between WBSF in the non-electrically stimulated sides of the carcasses and gregariousness (0.13), and the correlation between WBSF in the non-electrically stimulated sides of the carcasses and overall disposition at slaughter (0.12) was similar to the correlation with electrical stimulation, although the correlation without electrical stimulation was not significant.

Least squares means and standard errors for overall disposition for ET steers at slaughter by sire are presented in Table 30. Only an overall disposition score was taken at the time of slaughter for steers. The model was run with the number of knocks; that is, the number of times an animal had to be struck with a captive bolt gun before being immobile enough to be exsanguinated; first as a class variable, then as continuous variable, and finally, without the number of knocks included. For both models where knock was included, this effect was significant. In addition, when number of knocks

was included as a class variable, sire was significant and slaughter order was significant for all three models. For all 3 models, sire 297J was the lowest and 437J was the highest for overall disposition. Sire 432H was second lowest when number of knocks is included as a class variable, but was the second highest for the other two models. Sire 551G was the second highest when number of knocks is included as a class variable and was second lowest for the other two models. Sire 297J was significantly lower than 437J for both models with number of knocks included and was also lower than 551G when number of knocks was included as a class variable. There were no significant differences between sires for the model with number of knocks excluded.

Table 30. Least squares means and standard errors (SE) for overall disposition at slaughter by sire for ET calves (n = 204)

Sire	Slaughter Disposition ± SE[a]	Slaughter Disposition ± SE[b]	Slaughter Disposition ± SE[c]
297J	2.10 ± 0.20	2.00 ± 0.22	1.96 ± 0.23
432H	2.51 ± 0.25	2.39 ± 0.27	2.31 ± 0.28
551G	2.67 ± 0.19	2.36 ± 0.19	2.30 ± 0.20
437J	2.83 ± 0.20	2.64 ± 0.22	2.56 ± 0.23

[a] With number of knocks as a class variable
[b] With number of knocks as a continuous variable
[c] Without number of knocks

Table 31 presents the least squares means and standard errors for overall disposition for ET steers at slaughter by family. Again, the model was run 3 ways with number of knocks as a continuous or class variable or without number of knocks. Families in Table 31 were listed in ascending order by their slaughter disposition when knock was included as a class variable. Family 70, sired by 297J, and 83, sired by 437J,

were the lowest for all 3 models, while family 74, sired by 437J, was the highest for all 3 models.

Table 31. Least squares means and standard errors (SE) for overall disposition at slaughter by family for ET calves

Family	Number of steers	Sire	Slaughter Disposition ± SE[a]	Slaughter Disposition ± SE[b]	Slaughter Disposition ± SE[c]
70	17	297J	1.97 ±0.28	1.89 ± 0.33	1.84 ± 0.34
83	11	437J	2.14 ± 0.34	1.88 ± 0.38	1.76 ± 0.40
71	22	297J	2.22 ± 0.25	2.11 ± 0.26	2.07 ± 0.27
76	5	551G	2.28 ± 0.49	1.80 ± 0.50	1.66 ± 0.52
73	5	432H	2.37 ± 0.48	2.24 ± 0.50	2.23 ± 0.52
82	6	432H	2.57 ± 0.49	2.50 ± 0.54	2.35 ± 0.55
72	22	432H	2.59 ± 0.25	2.43 ± 0.27	2.35 ± 0.28
77	22	551G	2.61 ± 0.27	2.47 ± 0.28	2.35 ± 0.29
75	14	437J	2.69 ± 0.31	2.45 ± 0.35	2.42 ± 0.36
84	12	551G	2.70 ± 0.33	2.43 ± 0.36	2.33 ± 0.37
81	31	437J	2.93 ± 0.21	2.82 ± 0.25	2.74 ± 0.26
80	33	551G	3.08 ± 0.24	2.74 ± 0.27	2.86 ± 0.28
74	4	437J	3.57 ± 0.57	3.41 ± 0.62	3.33 ± 0.65

[a] With number of knocks as a class variable
[b] With number of knocks as a continuous variable
[c] Without number of knocks

Table 32 presents the least squares means and standard errors for overall disposition for all steers at slaughter. The same 3 models were run for all steers. Sire 297J was still the lowest for all 3 models, and sire 437J was still the highest. Sires 432H and 551G were intermediate for all 3 models; 432H was the second lowest and 551G was the second highest. Again, the model was also run with overall weaning disposition and overall weaning disposition was significant for both ET calves and all calves. The regression coefficients for overall disposition at slaughter on overall weaning disposition were 0.21 for ET calves and 0.17 for all calves when the number of knocks was not

included in the model and 0.19 for ET and 0.15 for all calves when the number of knocks was included as a continuous variable ($P < 0.001$).

Least squares means and standard errors for overall disposition for all steers at slaughter by family are presented in Table 33. As with ET steers, family 70, sired by 297J, was the lowest for all three models. Family 74, sired by 437J, was the highest for all 3 models.

Table 32. Least squares means and standard errors (SE) for overall disposition at slaughter by sire for all calves (n = 297)

Sire	Slaughter Disposition ± SE[a]	Slaughter Disposition ± SE[b]	Slaughter Disposition ± SE[c]
297J	2.45 ± 0.16	2.27 ± 0.16	2.26 ± 0.16
432H	2.66 ± 0.21	2.46 ± 0.20	2.41 ± 0.21
551G	2.72 ± 0.18	2.48 ± 0.17	2.51 ± 0.18
437J	2.89 ± 0.18	2.68 ± 0.17	2.70 ± 0.18

[a] With number of knocks as a class variable
[b] With number of knocks as a continuous variable
[c] Without number of knocks

Table 33. Least squares means and standard errors (SE) for overall disposition at slaughter by family for all calves

Family	Number of steers	Sire	Slaughter Disposition ± SE[a]	Slaughter Disposition ± SE[b]	Slaughter Disposition ± SE[c]
70	17	297J	2.07 ± 0.30	1.91 ± 0.29	1.94 ± 0.31
71	22	297J	2.33 ± 0.26	2.13 ± 0.25	2.13 ± 0.26
83	11	437J	2.33 ± 0.35	2.13 ± 0.34	2.03 ± 0.36
76	5	551G	2.33 ± 0.53	2.13 ± 0.52	2.09 ± 0.54
73	5	432H	2.47 ± 0.52	2.25 ± 0.51	2.31 ± 0.54
75	14	437J	2.50 ± 0.32	2.27 ± 0.32	2.34 ± 0.33
77	22	551G	2.59 ± 0.27	2.41 ± 0.26	2.34 ± 0.27
96	39	432H	2.68 ± 0.22	2.49 ± 0.21	2.41 ± 0.22
72	22	432H	2.71 ± 0.26	2.52 ± 0.25	2.42 ± 0.26
98	7	551G	2.75 ± 0.44	2.45 ± 0.44	2.54 ± 0.46
82	6	432H	2.78 ± 0.50	2.58 ± 0.49	2.50 ± 0.52
84	12	551G	2.83 ± 0.34	2.64 ± 0.33	2.62 ± 0.35
95	25	297J	2.94 ± 0.25	2.77 ± 0.24	2.70 ± 0.25
81	31	437J	2.97 ± 0.22	2.79 ± 0.21	2.75 ± 0.22
97	22	437J	3.07 ± 0.27	2.86 ± 0.26	2.91 ± 0.28
80	33	551G	3.10 ± 0.24	2.77 ± 0.24	2.95 ± 0.25
74	4	437J	3.57 ± 0.61	3.36 ± 0.60	3.46 ± 0.63

[a] With number of knocks as a class variable
[b] With number of knocks as a continuous variable
[c] Without number of knocks

Simple correlations between slaughter disposition and overall weaning disposition, disposition shortly before slaughter, and number of knocks for ET steers are presented in Table 34, and for all steers in Table 35. Slaughter disposition was moderately positively correlated with overall weaning disposition, disposition shortly before slaughter and number of knocks (range from 0.262 to 0.334, $P < 0.001$). Overall weaning disposition was the most strongly associated with slaughter disposition both for ET steers (0.334) and all steers (0.300), $P < 0.001$.

Table 34. Simple correlations between slaughter disposition and overall weaning disposition, overall disposition shortly before slaughter and number of knocks for ET calves

	Overall Weaning Disposition	Overall Disposition shortly before slaughter	Number of knocks
Slaughter Disposition	0.334 < 0.001	0.298 < 0.001	0.262 < 0.001

Table 35. Simple correlations between slaughter disposition and overall weaning disposition, overall disposition shortly before slaughter and number of knocks for all calves

	Overall Weaning Disposition	Overall Disposition shortly before slaughter	Number of knocks
Slaughter Disposition	0.300 < 0.001	0.267 < 0.001	0.281 < 0.001

Disposition of Females at Calving

Least squares means and standard errors for disposition by sire in first calf heifers produced by ET are presented in Table 36. The model was run with Julian date of calving within calving year and season included and without; both of the results are presented. For both models, the only significant factor was sire. The number of observations for first calf heifers was only 109, which may contribute to very few factors being significant. In both models, sire 432H was the lowest (most desirable) and 437J was the highest; 297J was the second lowest in both models as well. Both 432H and 297J were significantly lower than 437J, but no other differences were significant.

Table 36. Least squares means and standard errors (SE) for disposition by sire in first calf heifers produced by ET (n = 109)

Sire	First calf heifer disposition ± SE[a]	First calf heifer disposition ± SE[b]
432H	2.70 ± 0.65	2.27 ± 0.51
297J	2.76 ± 0.55	2.34 ± 0.39
551G	3.09 ± 0.55	2.68 ± 0.39
437J	3.85 ± 0.51	3.40 ± 0.34

[a] With Julian calving date within calving year and season
[b] Without Julian calving date

Table 37 presents the least squares means and standard errors for disposition by family for ET first calf heifers. Families were ranked by disposition with Julian calving date included. Family 73, sired by 432H, was the lowest for both the model that includes Julian calving date and for the model that does not include it; however, it should be noted that family 73 only had 2 first calf heifers. Families 81, 74, and 75, all sired by 437J, were the highest for both models.

Table 37. Least squares means and standard errors (SE) for disposition by family in first calf heifers produced by ET

Family	Number of heifers	Sire	First calf heifer disposition ± SE[a]	First calf heifer disposition ± SE[b]
73	2	432H	1.20 ± 1.05	0.81 ± 0.97
76	2	551G	2.31 ± 1.05	1.81 ± 0.97
71	11	297J	2.64 ± 0.59	2.27 ± 0.46
83	12	437J	2.77 ± 0.66	2.28 ± 0.48
70	8	297J	2.89 ± 0.67	2.42 ± 0.53
77	12	551G	3.14 ± 0.63	2.66 ± 0.47
80	12	551G	3.25 ± 0.59	2.94 ± 0.45
72	13	432H	3.32 ± 0.67	2.77 ± 0.49
82	2	432H	3.58 ± 1.01	3.21 ± 0.94
84	8	551G	3.66 ± 0.65	3.31 ± 0.54
81	13	437J	3.83 ± 0.56	3.49 ± 0.43
74	3	437J	4.35 ± 0.91	3.91 ± 0.85
75	11	437J	4.43 ± 0.63	3.93 ± 0.45

[a] With Julian calving date within calving year and season
[b] Without Julian calving date

Least squares means and standard errors for disposition by sire for all first calf heifers are presented in Table 38. When both ET and natural service first calf heifers were included, the number of observations increased to 162. In addition, when all first calf heifers were included, family within sire became significant and sire was no longer significant. Also, calving year and season within cow birth year and season was significant when Julian calving date was included. As with ET first calf heifers, sire 432H was lowest for both models (again, note that family 73 was sired by 432H and only had two first calf heifers), while sire 437J was the highest. Again, 432H was significantly lower than 437J for both models, and sire 297J, which was the second lowest, was also significantly lower than 437J when Julian calving date was not included. Sire 551G was the second highest and was not significantly different from any other sire.

Table 38. Least squares means and standard errors (SE) for disposition by sire in all first calf heifers (n = 162)

Sire	First calf heifer disposition ± SE[a]	First calf heifer disposition ± SE[b]
432H	2.85 ± 0.46	2.20 ± 0.35
297J	3.05 ± 0.40	2.40 ± 0.28
551G	3.28 ± 0.42	2.64 ± 0.29
437J	3.65 ± 0.38	3.10 ± 0.28

[a] With Julian calving date within calving year and season
[b] Without Julian calving date

Table 39 presents the least squares means and standard errors for disposition in all first calf heifers by family. Again, families were listed in ascending order according to disposition score when Julian calving date was included in the model. Rankings were similar to those when just ET heifers were included. Family 73, sired by 432H, was still

the lowest in both models and families 74, 81, and 75 (all sired by 437J) were still the highest for both models.

Simple correlations between disposition in first calf heifers produced by ET and overall weaning disposition and disposition in females with their second calf are presented in Table 40. Simple correlations for all first calf heifers are presented in Table 41. Disposition in first calf heifers was moderately positively correlated with overall weaning disposition (0.307 for heifers produced by ET and 0.343 for all heifers, $P < 0.01$). In addition, disposition in first calf heifers was also positively correlated with disposition in females with their second calf (0.480 for heifers produced by ET and 0.526 for all heifers, $P < 0.001$).

Table 39. Least squares means and standard errors (SE) for disposition by family in all first calf heifers

Family	Number of heifers	Sire	First calf heifer disposition ± SE[a]	First calf heifer disposition ± SE[b]
73	2	432H	1.39 ± 0.95	0.77 ± 0.91
76	2	551G	2.51 ± 0.95	1.77 ± 0.91
71	11	297J	2.55 ± 0.47	2.04 ± 0.39
96	29	432H	2.76 ± 0.41	2.16 ± 0.30
97	5	437J	2.77 ± 0.60	2.31 ± 0.56
83	12	437J	3.05 ± 0.52	2.33 ± 0.40
70	8	297J	3.12 ± 0.54	2.38 ± 0.45
77	12	551G	3.24 ± 0.51	2.51 ± 0.39
98	7	551G	3.35 ± 0.59	2.72 ± 0.50
80	12	551G	3.45 ± 0.48	2.92 ± 0.39
95	12	297J	3.47 ± 0.49	2.77 ± 0.39
72	13	432H	3.51 ± 0.49	2.73 ± 0.36
82	2	432H	3.75 ± 0.89	3.13 ± 0.85
84	8	551G	3.83 ± 0.53	3.25 ± 0.46
74	3	437J	3.87 ± 0.77	3.54 ± 0.75
81	13	437J	4.09 ± 0.45	3.51 ± 0.35
75	11	437J	4.47 ± 0.50	3.80 ± 0.40

[a] With Julian calving date within calving year and season
[b] Without Julian calving date

Table 40. Simple correlations between disposition in first calf heifers produced by ET and overall weaning disposition and disposition in females with their second calf

	Overall Weaning Disposition	Disposition in Females with Second Calf
Disposition in First Calf Heifers	0.307 0.001	0.480 0.001

Table 41. Simple correlations between disposition in all first calf heifers and overall weaning disposition and disposition in females with their second calf

	Overall Weaning Disposition	Disposition in Females with Second Calf
Disposition in First Calf Heifers	0.343 <0.001	0.526 <0.001

Simple means and standard deviations for the 4 component traits and overall disposition at weaning and shortly before slaughter, and overall disposition at slaughter (all on a scale of 1 to 9) and in first calf heifers (on a scale of 1 to 5) are presented in Table 42. Overall disposition decreased as age increased, with the highest overall disposition seen in calves at weaning (3.97) and the lowest mean overall disposition seen in first calf heifers (2.40, but note the difference in the scale). In addition, nervousness and flightiness had the highest means at weaning and shortly before slaughter, and the mean for aggressiveness was lower than the other component traits and overall disposition at weaning and shortly before slaughter. Standard deviations ranged from 1.79 to 2.05 for weaned calves, and 0.56 to 1.38 for steers shortly before slaughter. The standard deviation for steers at slaughter was 1.14 and for first calf heifers was 1.24.

Table 42. Means and standard deviations (SD) for four component traits and overall disposition at weaning and shortly before slaughter and overall disposition at slaughter and in first calf heifers

	Aggressiveness ± SD	Nervousness ± SD	Flightiness ± SD	Gregariousness ± SD	Overall ± SD
Weaning	2.92 ± 1.79	4.31 ± 1.99	4.08 ± 2.04	3.88 ± 1.89	3.97 ± 2.05
Before Slaughter	1.10 ± 0.56	3.26 ± 1.38	3.25 ± 1.38	2.33 ± 1.33	3.08 ± 1.19
Slaughter					2.46 ± 1.14
First Calf Heifers					2.40 ± 1.24

SUMMARY

Aggressiveness, nervousness, flightiness, gregariousness and overall disposition were evaluated at weaning in all calves, and in steers shortly before slaughter in F_2 Nellore/Angus full sib ET families and in half sib natural service families. Overall disposition was also evaluated for steers at slaughter and for females at calving. In addition, residuals were calculated for all 5 traits at weaning, for overall disposition shortly before slaughter, and for overall disposition in first calf heifers.

The differences between sires, families, and gender were significant for weaned calves. Sire 297J was the lowest (most desirable) for ET calves and all calves across all 5 disposition traits, and sire 437J was the highest. In addition, family 71, sired by 297J, was the lowest for all disposition traits for ET calves and all calves and family 74, sired by 437J, was the highest. Bulls had the lowest overall disposition, although it is important to note that there were only 10 bulls in this study, and heifers had the highest overall disposition, while steers were intermediate both for ET calves and all calves. Furthermore, there was a significant gender by sire interaction for both ET calves and all calves. Recipient disposition was also significant for ET calves and sequence of calves within pens was significant for ET calves and all calves. This suggests that both genetics and environment, as it relates to the disposition of the recipient and to the sequence of evaluation under the postweaning evaluation regime, influence the disposition of an animal at weaning.

All 4 component traits in the evaluation shortly after weaning were highly correlated with each other and with overall disposition for ET calves and in all calves

(from 0.734 to 0.985). In addition, the correlation between overall disposition and recipient disposition was low (0.116 when scores were averaged across evaluators and 0.096 when the individual scores from evaluators were included) but significant.

Family was significant for aggressiveness, nervousness, flightiness, gregariousness, and overall disposition shortly before slaughter for ET calves and for all calves. Sire was significant for nervousness, flightiness, and overall disposition for all calves and was also significant for overall disposition for ET calves. In addition, birth year and season was significant for nervousness, flightiness, gregariousness and overall disposition for all calves, and feed pen was significant for nervousness and flightiness for all calves. In general, both sires and families that had low least squares means for aggressiveness shortly before slaughter had high least squares means for the other component traits. This may be due, at least in part, to the fact that aggressiveness is a measure of an animal's willingness or desire to hit the evaluator. Because of this, some of the "tame" or calm animals may have been given high aggressiveness scores, because they wanted to hit the evaluator in a playful way. If aggressiveness is not considered, sire 297J was again the lowest for the component traits and for overall disposition shortly before slaughter for ET calves and for all calves. In addition, sire 437J was still the highest for all component traits except aggressiveness, and for overall disposition shortly before slaughter for ET calves and for all calves. Family 71, sired by 297J, had the lowest least squares mean overall disposition shortly before slaughter for ET steers and for all steers. This is consistent with the results from the weaned calves as family 71 was also the lowest for all component traits and overall disposition in ET calves and all

calves at weaning. Furthermore, family 74, sired by 437J, had the highest least squares means at weaning and was the highest for all component traits except aggressiveness and for overall disposition shortly before slaughter for ET steers and all steers.

Overall weaning disposition was moderately positively correlated with overall disposition shortly before slaughter for ET steers (0.409) and for all steers (0.430). In addition, all 4 component traits shortly before slaughter were positively correlated with overall disposition shortly before slaughter (0.183 to 0.925); but aggressiveness was not significantly correlated with any of the other component traits.

Only overall disposition was recorded at slaughter. The model for this was run 3 ways. For all 3 models slaughter order and overall disposition at weaning was significant. In addition, the number of knocks was significant for both models where number of knocks were included and sire was significant for the model with number of knocks as a class variable. For all 3 models for both ET calves and for all calves, sire 297J again had the lowest least squares means overall disposition. Sire 297J consistently had the lowest overall disposition at weaning, in steers shortly before slaughter, and in steers at slaughter. Sire 437J had the highest least squares mean overall disposition for all 3 models. Family 74, sired by 437J, was the highest (least desirable) family for all 3 models for steers at slaughter, which is consistent with the weaning results and the results for steers shortly before slaughter. In addition, family 70, sired by 297J, was the lowest for all 3 models for steers at slaughter. Family 71, which was the lowest for both overall disposition at weaning and for overall disposition shortly before slaughter, was the third lowest for ET calves and second lowest for all calves at slaughter.

Overall disposition for ET steers and for all steers at slaughter was moderately positively correlated with overall weaning disposition, overall disposition shortly before slaughter and number of knocks (correlations of 0.262 to 0.334, $P < 0.001$). Overall weaning disposition had the strongest relationship with overall disposition at slaughter for ET steers and for all steers (0.334 and 0.300, respectively).

Again, only an overall disposition was recorded for females as first calf heifers and subsequently when they calve the following years. The model was run 2 different ways; with the Julian date of calving included and without Julian date of calving. It is important to note that there were only 108 first calf heifers produced by ET and 162 total first calf heifers, which may account for few factors being significant. For first calf heifers produced by ET, sire was the only significant factor, and for all first calf heifers, family within sire was significant for both models and calving year and season within birth year and season was also significant when Julian calving date was included in the model. Sire 432H was the lowest (most desirable) for disposition in first calf heifers produced by ET and in all heifers in both models, and sire 297J was the second lowest. It should be noted that 432H was the worst for steers shortly before slaughter, and his low score in first calf heifers may be due to the small number of first calf heifers in family 73. Both of these sires were significantly lower than sire 437J, which had the highest least squares mean disposition in first calf heifers and also in weaned calves, steers shortly before slaughter and steers at slaughter. In addition, family 73, sired by 432H was the lowest for both models for heifers produced by ET and for all heifers

(again, note there were only 2 first calf heifers in this family), and families 74, 75, and 81, all sired by 437J, were the highest.

Disposition in first calf heifers produced by ET and in all first calf heifers was positively correlated with overall weaning disposition (0.307 and 0.343, respectively ($P < 0.05$)). There was also a significant positive correlation between disposition in first calf heifers and disposition in the females when they have their second calf (0.480 and 0.526, respectively).

In general, calves with better disposition at weaning tended to have better disposition throughout different stages of production. In addition, the sire (297J) with lower least squares means for disposition at weaning also had lower least squares means for disposition at other ages. One family, sired by 437J, was consistently one of the highest for all component traits at weaning and for traits in steers shortly before slaughter, steers at slaughter, and females as first calf heifers. Recipient disposition also had a significant effect on overall disposition at weaning. The results indicate that both genetics and environment, as it relates to recipient disposition, affect calf disposition at weaning, and these differences remain fairly consistent through different stages of the life of the animal.

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APPENDIX A

LEAST SQUARES MEANS BY SIRE AND FAMILY FOR OVERALL WEANING DISPOSITION WITHOUT SEQUENCE WITHIN PEN WITHIN BIRTH YEAR AND SEASON

Table A-1. Least squares means and standard errors (SE) for overall disposition at weaning by sire for ET and all calves

Sire	Overall Disposition[a] ± SE	Overall Disposition[b] ± SE
297J	2.72 ± 0.23	2.85 ± 0.23
432H	2.87 ± 0.25	2.98 ± 0.24
551G	3.47 ± 0.20	3.63 ± 0.20
437J	4.17 ± 0.21	4.28 ± 0.20

Means with no superscript in common differ ($P < 0.05$)
[a]ET calves
[b]All calves

Table A-2. Least squares means and standard errors (SE) for overall disposition at weaning by family for ET and all calves

Family	Sire	Overall Disposition[a] ± SE	Overall Disposition[b] ± SE
71	297J	2.22 ± 0.23	2.17 ± 0.24
96		—	2.65 ± 0.26
76	437J	2.50 ± 0.39	2.69 ± 0.40
73	432H	2.89 ± 0.41	2.94 ± 0.42
72	432H	2.86 ± 0.25	3.13 ± 0.26
95		—	3.19 ± 0.26
70	297J	3.23 ± 0.27	3.17 ± 0.28
83	551G	3.02 ± 0.23	3.23 ± 0.23
82	437J	2.87 ± 0.31	3.18 ± 0.31
77	432H	3.76 ± 0.23	3.76 ± 0.23
98		—	3.72 ± 0.31
80	437J	3.61 ± 0.22	3.89 ± 0.21
75	551G	3.91 ± 0.24	4.00 ± 0.23
97		—	4.06 ± 0.23
84	551G	4.02 ± 0.24	4.09 ± 0.24
81	551G	4.55 ± 0.22	4.72 ± 0.22
74	437J	5.18 ± 0.38	5.41 ± 0.39

[a]ET calves
[b]All calves

APPENDIX B

RESIDUALS FOR WEANED CALVES, STEERS SLIGHTLY BEFORE SLAUGHTER AND HEIFERS

Table B-1. Residuals for embryo transfer calves for all 5 disposition traits at weaning, overall disposition shortly before slaughter for steers, and at first calving for heifers

		Weaning Residuals					Steer Residuals	First Calf
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Heifer Residuals
70	7001	-0.21322	-1.19576	-0.92221	-1.67473	-0.91802	.	-0.3487715
70	7002	-0.68224	1.4766	1.10825	1.55344	0.93121	0.49647	.
70	7004	-1.32767	-1.51867	-1.76909	-1.53321	-1.37779	-0.2861	.
70	7005	-0.05875	-0.20555	-0.50782	-0.69085	-0.31594	-1.20426	.
70	7006	0.85706	1.1148	1.211	1.66683	1.31393	.	-0.610972168
70	7007	2.49608	1.96946	2.62514	2.54484	2.24652	0	.
70	7008	2.7466	2.34667	3.07775	3.64323	2.75984	-0.12966	.
70	7009	0.12902	0.3908	-0.54293	-0.17587	0.07719	0.43772	.
70	7010	-0.97929	-1.74985	-1.58837	-0.93782	-1.50261	.	0.100806968
70	7011	0.28823	-0.4741	-0.82178	-0.73754	-0.30935	-0.4313	.
70	7012	-0.75009	1.10446	1.04583	0.74676	0.95666	.	-0.057215013
70	7013	-1.23789	-0.93645	-0.74451	-0.75433	-0.61331	.	3.172679207
70	7014	1.76998	2.1426	2.59006	2.3433	2.16345	.	-0.899193032
70	7015	-0.61138	-1.35761	-1.15403	-0.44885	-0.99826	-0.42867	.
70	7016	-1.18067	-0.29243	-0.91671	-0.45135	-1.14615	0.42867	.
70	7017	0.79327	0.29624	0.79881	0.4994	0.58734	0.30352	.
70	7018	-1.69215	-1.7349	-1.94323	-1.93924	-1.94506	.	-0.669298812
70	7019	-1.66989	-1.92546	-1.895	-2.27686	-2.01092	-0.05306	.
70	7020	-0.38467	-1.1549	-1.10423	-0.98819	-0.9939	1.21511	.
70	7021	-2.30136	-3.57988	-4.05641	-3.6254	-3.48614	0	.
70	7022	-0.12525	-1.42106	-1.4661	-1.66704	-1.42794	.	-0.688035651
70	7023	1.46683	1.90135	1.65291	1.4	1.84449	.	.
70	7024	1.29247	2.01281	2.1153	1.37312	1.83662	0.37799	.
70	7025	-0.4318	0.24639	0.14736	0.80369	0.09143	.	.
70	7026	1.16426	1.56768	1.71672	0.60555	1.82919	.	.
70	7027	-0.91157	-0.6214	-0.54274	-0.60041	-0.56325	-0.56121	.
70	7028	-0.81504	-0.30757	0.07523	-0.35049	-0.5992	.	.
70	7029	-1.24135	-1.60118	-1.3649	-1.10562	-1.46124	-0.76953	.
70	7030	1.63833	2.11721	2.74213	1.4722	2.21442	.	.
70	7031	0.36567	0.5344	0.37724	0.64412	0.75228	0.60431	.
70	7033	0.02596	-0.06418	-0.4039	-0.06796	-0.27465	.	.
70	7035	0.74363	-0.33675	-0.58835	-0.33187	-0.38665	.	.
70	7036	0.83691	1.25625	1.04857	1.06116	0.72583	.	.
71	7101	0.64901	2.32477	2.07804	1.77823	1.94208	0.21399	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
71	7102	-0.33825	-1.60381	-1.65165	-2.04507	-1.50531	0.0888	.
71	7103	2.46447	3.99576	2.91792	3.13221	3.69871	.	-0.195793876
71	7104	0.09307	0.37022	1.07836	0.49174	0.58984	.	-0.195793876
71	7105	-1.67589	-2.13976	-2.06112	-2.15158	-1.98468	0.84029	.
71	7106	2.3112	3.16529	3.72995	2.40783	2.88245	.	.
71	7107	-1.63146	-0.90638	-1.01057	-1.02924	-1.28164	.	-0.395130617
71	7108	1.00509	0.61611	0.52025	0.53217	0.71882	0.08717	.
71	7109	0.40825	0.65928	0.58838	0.97317	0.69928	.	-0.358299208
71	7111	-0.12707	-1.13845	-0.83073	-0.84653	-0.63856	-0.31812	.
71	7112	-1.1191	-1.25903	-1.19752	-1.74708	-1.15227	0	.
71	7113	-0.26996	-0.96198	-0.81283	-0.65218	-0.72383	.	3.411806572
71	7114	0.56068	0.8323	0.54032	0.831	0.92017	.	1.253784592
71	7115	-0.24864	0.14441	0.03937	-0.06475	0.00682	-0.25065	.
71	7117	1.59408	2.68836	2.01474	1.99747	2.51974	-0.33704	.
71	7118	-0.67428	-0.43776	-0.10481	0.62065	-0.03949	0.42768	.
71	7119	-0.52433	-1.29903	-1.23796	-1.11648	-1.11346	.	-0.746215408
71	7120	-0.34612	-0.67777	-0.83675	-0.49113	-0.69035	.	-0.746215408
71	7121	-0.19876	0.11184	0.34576	-0.15175	-0.07129	.	-0.394299185
71	7122	-0.14263	-0.40051	-0.27122	-0.57926	-0.42654	-0.22312	.
71	7123	0.26939	0.45711	0.88047	0.40245	0.51864	-0.04455	.
71	7124	-2.25423	-2.33799	-2.65334	-2.57656	-2.75984	.	-1.239544401
71	7126	0.32373	0.36244	0.09268	-0.13597	-0.0233	-0.40738	.
71	7127	0.74181	0.64482	1.00114	0.98121	0.9987	-0.76764	.
71	7129	0.13467	0.59227	-0.09844	0.409	0.14154	.	-0.394299185
71	7131	0.45085	0.50412	0.2241	0.54998	0.31163	0	.
71	7132	0.35506	0.57919	0.80521	0.63035	0.47739	.	.
71	7133	0.07323	-0.33689	0.34227	0.12698	-0.191	.	.
71	7134	-0.17818	-0.51467	-0.74534	-0.41366	-0.49762	.	.
71	7135	-0.77874	-1.93494	-2.40234	-1.98167	-2.12746	0.29165	.
71	7136	-0.12296	-0.39484	-0.43535	-0.63855	-0.5348	1.19721	.
71	7137	-0.40863	-1.10886	-1.07281	-0.78999	-0.89933	.	.
71	7138	-0.86301	-1.19222	-0.91525	-0.3585	-1.02468	-0.94553	.
71	7139	-0.4477	-0.63254	-0.71329	-0.57357	-0.61288	.	.
71	7140	-0.03775	0.09336	0.58749	0.09885	0.39949	.	.
71	7141	-0.13614	0.00574	-0.14575	-0.29534	-0.25526	.	.
71	7142	-1.51104	-2.24866	-1.90346	-1.48478	-1.96999	-1.10342	.
71	7143	-0.75495	-0.02286	-0.09891	0.07497	-0.41713	0.85567	.
71	7145	0.14373	-0.20344	-0.17435	0.01847	-0.14764	.	.
71	7146	-0.02707	-0.17284	-0.06566	-0.24254	-0.01626	.	.
71	7147	-0.37674	-1.43792	-1.3339	-0.80292	-1.03346	.	.
71	7148	-0.14721	0.07759	0.25654	0.0457	0.00072	.	.
71	7149	-0.37618	-0.28627	-0.19638	0.08282	-0.20608	0.6187	.
71	7150	-0.48455	1.18911	0.83756	1.01746	0.74504	0.1902	.
71	7151	3.09737	3.00087	2.85193	1.9454	2.90361	-0.41391	.
71	7152	0.3959	-0.03235	-0.06364	-0.02576	0.25709	.	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
71	7153	0.7454	0.23098	0.13081	0.35824	0.25755	.	.
71	7154	0.21434	1.33915	1.13891	1.3478	0.77489	.	.
71	7155	1.1854	0.62012	0.77403	0.65549	1.26432	.	.
71	7156	-0.19281	-0.10847	0.24974	-0.0303	-0.18592	.	.
71	7157	-0.2756	-0.35981	-0.29243	0.00423	-0.1835	.	.
71	7158	4.45968	3.48588	3.12124	2.25584	3.41283	.	.
71	7159	-0.47059	-0.15158	-0.34501	-0.30224	-0.23747	.	.
71	7160	-0.9555	-0.64528	-0.40585	-0.14981	-0.42749	.	.
71	7161	-2.06216	-2.21273	-2.08415	-1.40164	-2.08236	.	.
71	7162	-2.26367	-2.60381	-2.77222	-1.88247	-2.66659	.	.
71	7163	-0.72903	-0.38679	-0.31317	-0.20515	-0.4746	.	.
71	7164	0.44024	1.01812	0.74143	0.95045	0.75533	.	.
71	7165	0.56372	0.88942	1.01255	0.14405	1.16794	.	.
71	7166	0.56164	0.50802	0.84999	0.99237	0.72109	.	.
71	7168	-0.53386	-0.57827	-0.37712	-0.57684	-0.46929	.	.
71	7169	-0.34741	-0.63946	-0.81323	-0.51419	-0.67393	.	.
71	7170	0.79023	0.86129	0.68537	0.40089	0.6596	.	.
72	7201	-1.57918	-2.53949	-2.30749	-1.48126	-2.48282	.	-0.701799063
72	7202	2.58247	1.19713	1.0902	0.86667	1.5573	0	.
72	7203	0.61842	0.69176	0.69465	0.212	0.71866	-0.68258	.
72	7204	2.00041	1.35163	1.61165	0.72265	1.51599	-0.06399	8.88178E-16
72	7205	-1.4777	-0.4843	-0.30912	-0.23656	-0.70883	.	6.43929E-15
72	7207	-0.32447	0.25507	1.20398	1.0477	0.50696	-0.14667	.
72	7208	-1.09604	0.00829	0.49131	0.1405	0.16014	0.71066	.
72	7209	-0.28646	0.77596	0.81007	-0.08369	0.49094	.	8.88178E-16
72	7210	0.51416	1.50016	1.78171	1.36723	1.58118	.	-0.25222059
72	7211	1.14882	1.98239	1.39698	2.04619	1.97398	.	0.747779404
72	7212	2.75462	0.63431	1.67295	1.22077	1.57076	.	-0.41024257
72	7213	-0.78633	-1.25026	-1.62245	-1.75904	-1.34288	0.33704	.
72	7214	-1.36638	-0.93329	-1.05496	-1.66125	-1.17763	-1.09814	.
72	7215	1.09833	2.23197	1.74283	1.91991	1.54993	-0.50758	.
72	7216	0.82764	0.73204	0.14116	1.03856	0.764	-0.30352	.
72	7217	-0.74614	-0.02235	0.46918	-0.16823	-0.212	-0.03833	.
72	7218	-1.24982	-1.60813	-0.27815	-0.70429	-1.02348	.	-1.09419861
72	7219	-1.18939	-1.03102	-1.27317	-1.47904	-1.62087	.	-0.41024257
72	7220	1.25819	0.89314	1.3451	1.41427	1.10608	.	0.977673624
72	7221	-1.20244	-0.92089	-0.85803	-0.76888	-0.99516	.	-0.25222059
72	7222	-1.16533	-1.10289	-0.93859	-0.16316	-0.82252	-0.28057	.
72	7223	-0.50851	0.26428	0.29363	-0.36266	0.05589	1.8187	.
72	7224	1.63733	1.02389	0.9136	0.05073	1.18379	.	2.436534211
72	7225	1.49133	0.64406	0.65537	0.78885	0.78943	.	-1.04106321
72	7226	-0.08773	0.60154	0.29474	1.16301	0.36599	-0.06658	.
72	7227	-1.09485	-1.76992	-1.57463	-1.12479	-1.45793	0.21651	.
72	7228	-0.40843	-0.17425	-0.11318	0.49123	-0.41284	-0.31141	.
72	7229	-1.31212	-1.54279	-1.22753	-1.67088	-1.67173	.	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
72	7230	2.43917	2.01074	1.60111	1.07288	2.35803	0.00388	.
72	7231	-1.26835	-1.76053	-2.03589	-1.14361	-1.97937	0.33107	.
72	7232	-0.49408	-0.80835	-0.82671	-0.42891	-0.62587	-0.71399	.
72	7233	-2.05826	-2.38222	-2.74159	-1.6896	-2.58244	0.71399	.
72	7234	-0.86867	-0.79588	-0.87042	-0.25447	-0.70818	0	.
72	7235	0.0118	-0.02917	-0.18359	-0.03089	-0.12484	.	.
72	7236	1.63154	1.30359	1.00854	1.18235	1.45023	0	.
72	7237	-1.13813	-1.4491	-1.53026	-1.7656	-1.49896	.	.
72	7238	-0.57954	-0.39573	-0.54864	-0.3925	-0.55867	.	.
72	7239	1.60634	1.14039	0.99297	0.83035	1.30685	0.08151	.
72	7240	1.43728	2.381	1.29013	1.36361	1.68169	.	.
72	7241	1.14947	1.4368	1.07709	0.75044	1.29349	.	.
72	7242	-0.9615	-0.94482	-0.82251	-1.10178	-0.93296	.	.
72	7243	-0.59964	-0.5655	-0.54139	-0.84932	-0.56313	.	.
72	7244	-0.9431	-1.81032	-1.78439	-0.98928	-1.80822	.	.
72	7245	0.11916	0.75613	0.48172	0.51765	0.8133	.	.
72	7246	0.46614	0.50495	0.38199	0.10215	0.5167	.	.
73	7302	-0.1862	0.29899	-0.16435	0.71266	0.24365	-0.22413	.
73	7303	0.18859	0.20994	0.43176	0.25425	0.25871	-0.11669	.
73	7304	-1.50879	-1.57825	-1.93479	-1.591	-1.78531	.	6.66134E-16
73	7305	-0.12061	0.65494	0.46114	-0.10109	0.16856	-0.95098	.
73	7306	1.82205	1.44013	1.60335	1.47171	1.93342	.	.
73	7307	-0.77389	-1.29549	-1.12242	-0.79324	-0.99528	.	6.66134E-16
73	7308	2.23248	1.45923	2.07388	1.17792	1.58495	0.40505	.
73	7309	-1.65363	-1.1895	-1.34857	-1.1312	-1.40869	0.88674	.
74	7401	-2.6789	-1.33263	-1.46045	-1.58344	-2.21995	.	-0.833333333
74	7402	2.28298	0.67347	0.43265	0.89084	1.29475	0.3609	.
74	7403	2.23904	0.57187	0.311	0.77254	1.23874	.	1.166666667
74	7404	1.11504	0.01897	-0.0888	0.03486	0.33606	-0.49644	.
74	7405	-0.70429	-0.25511	0.45295	0.06754	-0.15265	0	.
74	7406	-1.32526	0.75964	1.23078	0.46778	0.16818	.	-0.333333333
74	7407	-0.28851	-0.13769	-0.71847	-0.38299	-0.30809	0.13555	.
74	7408	-0.6401	-0.29852	-0.15966	-0.26714	-0.35703	.	.
75	7502	1.16457	2.13401	1.10197	1.6705	1.5863	.	1.147386105
75	7503	-1.79149	-3.01439	-3.27638	-3.2112	-3.3577	-0.00145	.
75	7504	1.57992	0.61114	0.81317	0.67927	0.50117	0.85725	.
75	7505	-0.41411	0.07392	-0.12003	0.1776	0.20119	.	0.147386105
75	7506	-1.47	-2.95323	-2.87527	-1.93737	-2.50486	0.96652	.
75	7508	-0.37138	-0.61062	-0.50247	0.07517	-0.07506	.	0.147386105
75	7509	-1.02546	-2.34011	-2.01313	-2.26164	-2.28121	-0.76699	.
75	7511	-0.51273	-1.76869	-1.74283	-2.08493	-1.47861	-0.68681	.
75	7512	-1.07639	-0.95415	-1.01951	-1.17431	-0.95222	.	0.596964572
75	7513	-1.46005	-2.17304	-2.04041	-2.0692	-2.10903	.	-0.928969486
75	7514	0.05048	1.62247	0.70835	1.3465	1.02001	.	.
75	7515	1.61212	1.37203	1.84649	0.99978	1.34387	.	-2.205873989

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
75	7516	-0.71805	-0.68951	-1.0998	-1.04179	-0.89309	.	.
75	7517	-1.09519	-0.1636	0.30341	-1.01098	-0.04944	.	0.948880796
75	7518	1.60171	2.07874	2.44792	2.94273	2.31744	0.05385	.
75	7519	-0.71939	0.23488	-0.05635	-0.23567	-0.26324	0.50748	.
75	7520	-0.106	0.80596	0.31382	0.5331	0.47853	.	0.948880796
75	7521	0.57224	1.11557	1.40638	1.45649	1.29954	.	1.285719379
75	7522	1.02392	0.93514	1.38565	0.7543	1.40472	.	-1.714280621
75	7523	0.26571	0.02219	-0.19498	0.06886	0.02591	-1.6295	.
75	7525	2.12427	1.11538	1.46434	0.57444	1.32906	.	-0.373479763
75	7526	-0.37923	0.17417	0.77055	0.55176	0.18546	-0.13969	.
75	7527	0.73406	1.0028	1.74609	0.49873	1.27327	-0.64254	.
75	7528	0.40862	1.67873	1.74295	1.64317	1.73056	-0.21532	.
75	7529	-0.82046	-0.56635	-0.72149	-0.40646	-0.63908	.	.
75	7530	-0.51612	-0.44397	-0.06235	0.51871	-0.05455	.	.
75	7531	0.72498	0.53529	0.43976	0.22319	0.52366	0.50645	.
75	7532	0.57663	1.18726	1.08002	1.59806	1.02214	.	.
75	7535	-1.36356	-0.62866	-0.71687	0.08124	-0.74552	1.10342	.
75	7536	-0.42051	-0.65747	-1.09118	-0.81999	-0.99643	.	.
75	7538	0.21717	0.19897	0.21761	0.06362	0.17704	0.08733	.
75	7539	2.60626	1.68678	1.55245	0.91321	1.84021	.	.
75	7540	-0.13069	-0.38158	-0.23471	0.34459	-0.31629	.	.
75	7541	-0.23018	-0.48735	-0.44354	-0.48105	-0.57734	.	.
75	7542	-1.69186	-2.26326	-2.48847	-2.263	-2.23134	.	.
75	7543	1.05018	1.51056	1.35883	1.28257	1.26495	.	.
76	7601	0.89034	-0.03335	-0.14621	-0.23362	0.08496	1.78403	.
76	7603	0.35819	1.43553	1.56368	1.989	1.29967	-1.57263	.
76	7604	-0.84889	-1.12278	-1.18169	-0.89233	-1.03913	.	-0.531431963
76	7605	-1.48651	-1.53263	-1.38688	-1.71208	-1.68879	.	0.531431963
76	7606	0.94803	0.35428	1.11254	0.96945	0.58217	0.04249	.
76	7609	0.70589	1.5119	1.11364	0.86238	1.63892	0.18512	.
76	7610	-0.56706	-0.61295	-1.07509	-0.98279	-0.8778	-0.43901	.
77	7701	-1.46063	-0.96548	-1.12355	-0.52067	-1.33208	-0.85579	.
77	7702	-0.69823	0.15154	0.41762	0.07958	-0.25799	0.76653	.
77	7703	1.49343	1.01234	1.5595	1.54484	1.6469	.	-1.845397238
77	7704	-1.7517	-2.00388	-2.00629	-1.62478	-1.99315	.	-0.845397238
77	7705	-2.36445	-2.0335	-2.56491	-1.52195	-2.43057	-0.2827	.
77	7706	-1.76118	-3.16486	-3.29295	-2.99544	-3.10854	-1.05658	.
77	7707	-0.68606	-0.40795	0.00086	-0.70243	-0.34736	0.95098	.
77	7708	1.57988	2.35329	2.51808	2.1663	2.47386	.	0.623170798
77	7709	-0.71189	-1.30756	-1.69994	-1.58006	-1.20902	-0.60064	.
77	7710	2.35103	2.37883	2.74116	2.13208	2.3933	.	1.686034725
77	7711	2.08019	0.72036	1.06609	1.78371	1.37614	.	2.024403878
77	7712	0.13274	0.13755	-0.06606	0.16155	-0.30092	-1.65271	.
77	7714	0.91652	1.51579	1.2462	1.47267	1.30396	.	0.218298121
77	7715	-2.1325	-1.96582	-1.55867	-1.91281	-1.6035	1.1978	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
77	7716	-0.94336	-0.95582	-0.74218	-1.21966	-1.24402	-0.29984	.
77	7717	-0.08263	-0.78978	-0.69443	-0.97616	-0.8618	-0.10024	.
77	7718	1.77676	2.70308	2.43565	2.40732	2.58309	.	-0.444863295
77	7719	-2.11231	-3.32916	-3.41642	-3.04512	-3.31502	-0.00622	.
77	7720	1.81279	0.85646	0.40104	0.18273	0.85953	.	0.23673842
77	7721	0.07374	2.05664	1.53115	1.34351	1.81235	.	-0.444863295
77	7722	-0.49403	-0.0123	-0.39369	-0.15351	-0.11491	-0.56364	.
77	7724	1.92401	2.63716	2.70667	2.64385	2.97394	1.25914	.
77	7725	-1.98872	-2.75896	-3.24257	-2.48377	-3.01801	.	0.23673842
77	7726	-0.20015	0.65802	0.54433	0.40821	0.5329	0	.
77	7727	0	0	0	0	0	.	-1.444863295
77	7728	-0.43406	-1.53171	-1.64434	-0.83887	-1.68139	0.70457	.
77	7729	2.02539	0.57375	1.24782	0.88881	1.56414	0.16907	.
77	7730	2.42996	2.6436	2.74704	2.8418	2.94173	0	.
77	7731	-0.0208	0.42201	0.21269	0.06294	0.39643	-0.06204	.
77	7732	-1.50926	-0.54616	-0.41266	-0.47929	-0.80773	0.43229	.
77	7733	2.90361	2.08105	1.91369	1.26209	2.59976	.	.
77	7734	-1.29112	-1.43326	-1.12319	-1.15419	-1.26616	.	.
77	7735	-0.2	-0.2445	-0.44693	-0.77888	-0.65709	.	.
77	7736	-1.04687	-1.43847	-1.37548	-1.29689	-1.36035	0	.
77	7737	0.21221	0.70609	0.47235	1.20012	0.44202	0	.
77	7738	-2.18456	-2.54311	-2.12525	-2.2931	-2.44142	0	.
77	7739	2.22479	2.1963	2.17445	1.75363	2.10196	.	.
77	7740	0.10491	1.35973	1.57543	1.05327	0.95655	.	.
77	7741	-0.80404	-0.96984	-0.87666	-1.01068	-0.79094	.	.
77	7742	0.83658	1.23853	1.29433	1.19927	1.18339	.	.
80	8001	-0.56073	0.62639	0.67646	-0.24255	-0.07541	2.00551	.
80	8002	1.33397	1.78158	2.08468	2.4183	2.26684	.	1.335466619
80	8003	1.47383	2.42458	1.89169	2.41326	2.30009	-1.35538	.
80	8004	-0.18602	-1.1856	-1.39473	-1.53731	-1.13487	0.2163	.
80	8005	0.74411	0.05141	-0.44058	-0.50686	0.23705	0	.
80	8006	-1.26418	-0.62465	-0.59683	-0.77457	-0.91182	.	0.866898582
80	8007	-1.96072	-2.47895	-2.70586	-3.06666	-2.52259	-1.5665	.
80	8008	0.17096	0.31075	1.29777	1.14164	0.57253	0.48562	.
80	8009	-0.66136	0.51038	0.17501	0.46231	-0.2601	.	-1.133101418
80	8010	1.35607	2.28731	2.50738	2.4705	2.41136	0.68463	.
80	8011	-0.56636	-1.64808	-1.74122	-1.51906	-1.643	.	-1.421322282
80	8012	-1.49122	-0.38173	-0.8431	-0.97202	-0.99502	.	-1.191428062
80	8013	2.21592	3.56397	3.8708	2.25492	2.96303	0	.
80	8014	0.53277	0.50788	0.19006	0.19683	0.56386	0.78745	.
80	8015	-0.47877	-0.57294	-0.52113	-0.53457	-0.59754	0.51992	.
80	8016	2.25618	1.26714	1.62248	1.19527	1.64675	.	0.578677718
80	8017	-0.48945	0.60419	0.54761	0.65957	0.28638	.	-0.033406081
80	8018	-0.04971	-1.02608	-0.7945	-1.29741	-0.87082	.	.
80	8019	0.21277	-0.41415	-0.33938	-0.268	-0.24979	-1.01633	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
80	8020	0.24429	-0.08995	-0.16745	0.08728	-0.05025	0.83311	.
80	8021	-0.41355	-0.1217	0.00974	-0.68017	-0.33642	.	-0.224160843
80	8022	-1.07421	-1.95628	-1.69837	-1.6417	-1.51746	.	.
80	8023	1.44827	0.97837	0.97519	1.30373	1.44157	.	1.930593941
80	8024	0.07513	1.02053	1.39896	1.45576	1.20829	-0.50069	.
80	8025	-0.88247	-0.39491	-0.85962	-0.73377	-0.63329	-0.11129	.
80	8026	2.82427	1.66087	1.06663	1.8498	2.10905	0.1092	.
80	8027	-1.83506	-2.54817	-3.01051	-2.83669	-2.64255	.	-0.914651274
80	8028	-0.22571	-0.36253	-0.52312	-0.45633	-0.25256	.	-0.069406059
80	8029	-0.18032	0.12067	0.37864	0.90437	0.55301	.	.
80	8030	0.74189	0.24506	0.95387	0.99712	0.71708	0.34687	.
80	8031	-1.62728	-1.72569	-1.86782	-2.1201	-1.65764	.	.
80	8032	0.4227	0.41163	0.32617	0.28135	0.10923	-0.30956	.
80	8033	1.14761	1.83464	2.23351	2.13813	2.00835	-1.17377	.
80	8034	0.31989	0.08534	0.06716	0.57091	0.31521	.	.
80	8035	0.4548	0.91626	0.9316	0.67081	0.32836	-0.42678	.
80	8036	0.4019	1.64028	1.55907	1.54915	1.43414	-0.52355	.
80	8037	-0.56074	-0.7954	-1.23125	-1.21973	-1.2924	-1.46313	.
80	8038	-0.36736	-0.26259	-0.00828	-0.1693	-0.03175	1.25154	.
80	8039	-0.48036	-1.34391	-1.40652	-0.99648	-1.05239	.	0.275839157
80	8040	-0.2267	-0.53387	-0.68806	-0.74978	-0.53476	-1.16205	.
80	8041	1.65818	1.10557	1.02042	1.71903	0.90057	0.84755	.
80	8042	-0.21405	-0.15399	-0.61977	-0.31952	0.08793	1.39688	.
80	8044	0.08617	-0.34452	-0.32578	-0.39389	-0.07419	0.32288	.
80	8045	-1.04663	-2.3791	-2.35624	-2.15519	-2.16748	0.21896	.
80	8046	-1.05648	-0.56268	-0.74469	-0.40536	-1.03558	.	.
80	8047	-0.89153	-1.493	-1.41644	-1.5315	-1.77062	.	.
80	8048	0	0	0	0	0	.	.
80	8049	-0.46385	0.19548	0.54157	-0.21536	0.10221	.	.
80	8050	-0.81479	-1.96571	-1.59424	-1.81834	-1.58218	-0.69665	.
80	8051	-0.93365	-0.61554	-0.84499	-0.17648	-0.78286	0.96705	.
80	8052	0.15152	0.57235	0.88278	0.78335	0.46405	-0.11442	.
80	8053	1.96268	2.01753	1.91984	2.07047	2.38432	-1.01438	.
80	8055	2.18919	1.42773	1.09383	0.96181	1.48499	0.41391	.
80	8056	0.73139	0.85559	0.83785	0.12514	0.94702	0.02709	.
80	8057	0.27463	1.17511	1.01833	0.347	0.88348	.	.
80	8058	-0.2495	-0.84634	-0.76841	0.08754	-0.56837	.	.
80	8059	0.80483	1.33319	1.49963	1.13376	1.34256	.	.
80	8060	-2.41955	-1.26382	-0.81688	-0.88764	-1.06443	.	.
80	8061	-1.52518	-1.62619	-1.53899	-0.79423	-1.45406	.	.
80	8062	0.47808	0.74987	0.77702	0.36438	0.80682	.	.
80	8063	-1.98847	-2.15014	-2.27739	-1.70907	-2.34161	.	.
80	8064	0.97017	0.55781	0.89223	0.11794	1.0649	.	.
80	8066	-0.04047	-0.07567	-0.29057	0.63556	-0.5737	.	.
80	8067	-0.57359	-1.37893	-1.4413	-1.74425	-1.46735	.	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
80	8069	-0.15752	0.33469	0.55603	0.39447	0.2752	.	.
80	8070	0.27336	0.14864	0.07001	0.71239	-0.07137	.	.
81	8101	-1.84022	-2.81676	-2.63044	-2.59729	-2.83639	-0.12235	.
81	8102	0.52734	0.13197	-0.36814	0.70247	0.48733	.	.
81	8103	0.51327	-0.02235	-0.3039	0.06204	0.19239	.	-6.66134E-15
81	8104	-0.69749	-0.89596	-1.4533	-0.93529	-1.04554	.	0.318427955
81	8107	-2.78865	-3.24578	-3.59162	-3.28923	-3.43186	.	0.030207091
81	8108	1.78242	0.91021	0.86147	1.22342	1.34448	0.1782	.
81	8109	3.12167	1.93707	1.57946	1.00722	2.13073	.	-1.811770928
81	8110	-2.37847	-0.09641	-0.57336	0.41101	-0.81937	-0.42768	.
81	8111	-0.68787	1.11317	1.62624	1.61922	1.12293	0	.
81	8112	-1.31833	0.36685	0.20405	0.51284	0.13804	0.54055	.
81	8113	2.55412	1.8619	1.50299	1.00067	1.74338	-0.51992	.
81	8114	0.00091	-0.21975	-0.22841	0.40984	-0.02459	.	-0.969792909
81	8115	0.79925	0.36838	0.39312	0.67364	0.72992	1.20529	.
81	8116	0.90895	0.01701	0.7923	1.09464	0.21975	.	-1.897920669
81	8117	2.43094	1.19401	0.97705	0.20279	1.23834	-0.27987	.
81	8118	0.85492	0.5117	0.85595	1.21006	0.72191	.	-0.969792909
81	8119	2.15195	-0.2862	0.10797	0.16898	0.51043	.	2.030207091
81	8121	1.51588	1.06649	0.94793	0.57726	1.44492	1.41626	.
81	8122	-2.86172	-2.92104	-3.34985	-2.79183	-2.91055	0.25065	.
81	8123	-1.03378	0.87268	0.9909	0.57107	0.53266	-0.4819	.
81	8124	0.28503	0.37823	0.81188	-0.34503	-0.1498	.	.
81	8125	0.96164	0.54874	0.81705	0.20067	0.37289	-0.54055	.
81	8126	0.8673	0.34321	-0.03199	-0.48947	0.2902	-0.72338	.
81	8127	1.2099	-0.03355	0.29504	0.62534	0.30401	.	-0.127814889
81	8128	-0.3837	0.28677	0.39127	0.2069	0.10426	0.60619	.
81	8130	-1.82427	-1.4345	-1.7795	-1.35229	-1.64313	0.13179	.
81	8133	0.48091	0.9148	0.4425	0.56651	0.40146	0.95262	.
81	8134	2.45499	1.79108	2.2563	2.03217	2.16074	-0.29483	.
81	8137	0.23548	1.11468	1.09267	1.21461	0.93008	.	1.400563614
81	8138	0.23912	1.05457	0.98466	0.29472	0.91312	.	0.718961898
81	8139	0.75559	0.3318	0.85608	1.15428	0.54875	.	-0.281038102
81	8140	0.88042	1.53901	1.94918	1.34412	1.60983	-1.8187	.
81	8141	-3.16742	-4.6547	-4.45846	-4.30217	-4.44207	0.79295	.
81	8142	0	0	0	0	0	0	.
81	8144	0.33797	0.0302	0.07276	0.25295	0.06446	-0.48729	.
81	8145	-0.72791	-0.71965	-0.45379	0.24074	-0.57617	.	1.559762756
81	8146	0.69287	1.36956	0.63809	-0.12409	0.24757	0.01203	.
81	8147	-2.90297	-3.45335	-3.49537	-2.60577	-3.56052	0.01153	.
81	8148	1.45109	0.76285	1.20141	0.78143	1.16731	-0.03487	.
81	8149	1.10161	1.82056	1.61669	0.66202	1.63869	0.65896	.
81	8150	0.51409	0.53095	0.52782	0.48418	0.96688	-0.23193	.
81	8151	-1.50169	-0.30058	-0.67741	-0.17827	-1.00315	0.7148	.
81	8152	0.32264	0.55808	0.19838	0.77772	0.5798	.	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer Residuals
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
81	8153	0.97174	1.24288	1.33178	0.42705	0.93433	.	.
81	8154	0	0	0	0	0	.	.
81	8155	0.71714	0.54352	1.12138	0.02454	0.99282	.	.
81	8156	1.14372	0.96733	0.84349	1.05069	0.9182	-0.85567	.
81	8157	0.65151	0.59691	0.65282	0.19085	0.53113	-0.70021	.
81	8159	-0.11013	1.04525	0.82476	1.23998	0.85483	-0.96705	.
81	8160	-0.68377	-1.04586	-0.82207	-1.33753	-0.9031	1.01438	.
81	8161	-0.33444	0.47111	0.65241	0.8829	0.50046	.	.
81	8162	-2.09651	-2.33657	-2.17539	-2.30966	-2.39657	.	.
81	8163	-3.36692	-2.58206	-2.30837	-2.17384	-2.80858	.	.
81	8164	0.48654	0.05657	-0.3237	0.38291	0.48446	.	.
81	8165	-3.0004	-3.01179	-3.11087	-2.43572	-2.92204	.	.
81	8166	-0.93901	0.36662	0.61005	0.20287	0.21771	.	.
81	8167	0.72276	1.06015	1.10807	0.58013	1.1822	.	.
82	8201	0.48515	0.68806	0.58275	0.5365	0.38441	.	4.44089E-16
82	8202	-0.21456	0.49216	0.40907	0.87693	0.75538	.	4.44E-16
82	8203	1.45325	1.29626	1.32068	1.04327	1.3251	.	.
82	8204	0.63418	1.09637	1.24311	1.2994	1.132	0.00021	.
82	8205	-1.5318	-1.39722	-1.39593	-0.9188	-1.36583	.	.
82	8206	2.09779	1.9322	1.59298	1.35006	1.83769	.	.
82	8207	-0.255	1.17001	0.95228	0.70361	0.9668	-0.42881	.
82	8208	0.24869	-0.07953	0.30629	0.17386	-0.00014	-0.18431	.
82	8209	-1.08638	-2.0691	-2.09693	-1.99398	-1.86868	-0.37298	.
82	8210	-2.32959	-2.23257	-2.19348	-1.7368	-2.33118	.	.
82	8211	1.03601	0.94655	0.92325	0.37926	0.70352	0.98589	.
82	8213	-1.15441	-2.07318	-1.84288	-1.96076	-1.96511	.	.
82	8215	-0.34484	-0.71482	-0.62371	-0.85434	-0.5069	.	.
82	8216	0.9615	0.94482	0.82251	1.10178	0.93296	.	.
83	8301	-2.00468	-0.53966	-0.50254	-1.31676	-0.85738	.	-0.917616322
83	8302	-1.7704	-1.45354	-2.07288	-1.80005	-1.96622	.	1.240405659
83	8303	-0.71607	-1.29214	-1.20873	-1.24356	-1.03375	1.65271	.
83	8304	-1.09813	-1.80636	-1.87361	-1.74097	-1.67084	-0.78439	.
83	8305	-0.82387	-0.33196	-0.38708	-0.31856	-0.4976	0.46963	.
83	8306	0.5868	1.68501	1.92519	1.76993	1.48349	-1.91858	.
83	8307	-1.9351	-2.66926	-2.2844	-2.7581	-2.57116	.	.
83	8308	1.70307	2.34226	2.62644	2.48355	2.55642	1.73711	.
83	8309	-1.54769	-3.4313	-3.87154	-3.44851	-3.63219	.	-0.230038676
83	8310	1.68772	0.99977	1.02247	0.64458	1.07395	.	0.769961324
83	8311	-2.85271	-3.87026	-3.79499	-2.76455	-3.76044	.	0.429160466
83	8312	-0.35972	-1.63832	-1.77827	-1.55637	-1.61271	0.28057	.
83	8313	0.76407	2.34961	2.29039	2.25834	2.50207	.	-1.389237818
83	8314	-0.74618	0.76888	1.29964	1.09788	0.65055	0.10317	.
83	8315	0.02876	1.79547	1.50001	0.6819	1.31175	0.00622	.
83	8316	1.77483	2.42968	1.7627	2.07762	2.31493	.	0.769961324
83	8317	1.62669	1.43226	1.85727	1.59926	1.6226	.	0.769961324

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residuals
83	8320	-1.77159	-2.72453	-2.89504	-1.61261	-2.53799	.	-1.070839534
83	8321	-0.08558	1.37474	1.26895	1.07222	1.19782	.	-0.070839534
83	8322	1.86455	0.67789	0.47203	0.03027	0.2805	.	-1.070839534
83	8323	-0.68458	-0.57526	-0.79325	-0.52742	-0.84264	-0.10317	.
83	8325	0.33948	1.39424	1.82353	2.02902	1.44678	.	0.769961324
83	8326	-1.19211	-2.30517	-2.22543	-1.51058	-2.10864	-0.28548	.
83	8327	2.09517	2.20165	1.91112	1.54458	2.51159	.	.
83	8328	-1.34074	-1.99771	-2.10301	-1.43705	-2.06042	-1.15779	.
83	8329	1.25015	1.3737	1.35412	0.95045	1.55025	.	.
83	8330	0.74966	1.5795	1.89669	1.64895	1.70417	.	.
83	8332	-2.50896	-2.98114	-2.41517	-1.95829	-2.4576	.	.
83	8333	3.49334	2.81733	2.88603	2.57588	3.43039	.	.
83	8334	2.87676	1.55347	1.92296	1.21949	2.0811	.	.
83	8335	-0.98504	-0.4497	-0.75767	-0.65409	-0.95256	.	.
83	8336	-1.11893	0.22018	0.18972	-0.09272	-0.30063	.	.
83	8337	-1.00132	-1.56363	-1.49899	-1.14398	-1.40106	.	.
83	8338	2.0458	1.53982	1.37372	1.23811	1.61316	.	.
83	8339	1.65656	1.09448	1.07963	0.96216	0.9323	.	.
84	8401	-0.94217	-1.48558	-2.01337	-1.25688	-1.40478	.	-0.440128938
84	8402	0.96374	0.82678	1.32125	1.19203	1.04008	.	1.559871062
84	8403	-0.26794	0.31409	-0.24201	-0.04624	-0.14766	-0.50748	.
84	8404	-0.4223	-1.07738	-1.11006	-1.95253	-1.13499	0.74197	.
84	8405	-0.49512	-1.09555	-1.36825	-0.69191	-0.9074	.	-1.103290354
84	8406	1.01392	1.47164	1.52987	0.7383	1.14029	.	-1.103290354
84	8407	0.34645	0.97621	0.68887	1.68334	1.18758	0.7751	.
84	8408	0.21449	0.88665	0.96718	0.87417	1.06192	0	.
84	8409	-2.34717	-3.73856	-3.87246	-3.39754	-3.6012	.	1.896709646
84	8410	-1.1352	-2.4912	-2.37576	-2.32779	-2.19509	0.13969	.
84	8411	-1.1594	0.31949	0.55167	0.00519	-0.01747	.	-0.262489496
84	8412	-1.13179	-1.66613	-1.73308	-1.26665	-1.46746	-0.3474	.
84	8413	-0.07774	0.95469	0.92301	1.06611	0.9005	-0.94359	.
84	8414	1.04384	0.51036	0.84197	1.01291	0.67568	-1.0846	.
84	8416	-0.94919	-0.37587	0.04267	0.00348	-0.4373	.	-0.103290354
84	8417	0.41102	0.92762	0.91258	1.65108	0.84456	.	-0.444091212
84	8418	2.60168	1.11505	1.00043	1.12815	1.13336	0.78521	.
84	8419	0.9793	2.0994	2.23025	1.00491	2.06116	0.42771	.
84	8420	0.15181	0.76904	0.61182	0.21617	0.59501	0.6267	.
84	8421	-1.10465	-0.22793	-0.20522	0.07791	-0.63561	-0.61331	.
84	8422	0.32117	0.25448	0.55005	0.35511	0.36817	.	.
84	8423	-0.06995	0.11549	0.40635	0.04734	0.10204	.	.
84	8424	-0.69365	-0.69715	-1.10551	-0.54877	-0.9002	.	.
84	8425	-0.15161	-0.83071	-0.94651	-0.99108	-0.92677	.	.
84	8426	1.84535	2.11629	1.94234	1.90319	2.21906	.	.
84	8427	-0.90466	-1.37764	-1.23604	-1.14184	-1.24706	.	.
84	8428	-0.07701	-0.11673	0.15679	0.24263	-0.13524	.	.

Table B-1 Cont.

		Weaning Residuals					Steer Residuals	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residuals
84	8429	2.21874	1.81607	1.58021	0.51381	2.02467	.	.
84	8430	-0.18198	-0.29291	-0.04903	-0.09458	-0.19585	.	.

Table B-2. Residuals for natural service calves for all 5 disposition traits at weaning, overall disposition shortly before slaughter for steers, and at first calving for heifers

		Weaning Residuals					Steer Residual	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residual
95	9501	0.67598	0.7362	0.70314	1.31029	1.3616	.	-0.24127
95	9503	-1.05485	1.76043	0.57695	0.70418	0.65693	.	0.00722
95	9504	0.75819	0.92055	0.90081	0.81185	0.79789	0	.
95	9505	-0.70618	-1.29538	-1.29591	-1.35618	-0.82979	.	.
95	9506	-0.14161	0.01627	-0.50047	-0.24366	-0.28986	0	.
95	9507	-0.4885	0.12231	0.37816	-0.41159	-0.17645	0	.
95	9508	-0.61313	-1.18891	-1.12273	-1.01477	-1.18477	.	0.00722
95	9509	-1.37662	-1.23188	-1.32347	-1.37031	-1.38696	.	1.82271
95	9510	0.44617	1.32638	1.0261	1.08651	1.19867	-0.65879	.
95	9511	-0.295	0.054	-0.52794	0.0236	-0.2076	0.65879	.
95	9512	-1.49606	-0.74186	-0.93163	-1.43019	-0.91621	.	0.00722
95	9513	-0.48977	-0.59649	-0.93315	-1.07398	-0.67032	.	2.00722
95	9514	0.04874	-0.03169	0.17715	-0.5469	0.03631	0	.
95	9515	2.58399	2.63718	2.3205	2.00891	2.23676	1.68731	.
95	9516	-0.19481	0.08722	0.41807	0.34106	-0.06703	.	0.00722
95	9517	1.81148	0.73258	0.91655	0.94726	1.17886	.	0.00722
95	9518	-1.46573	-1.98572	-1.49826	-1.70806	-1.86502	.	-0.99278
95	9519	1.18963	1.18026	1.41579	1.75037	1.17681	.	-1.17729
95	9520	-0.76708	-2.2872	-2.27534	-2.08765	-2.00724	.	-1.47733
95	9521	-0.72089	-1.12261	-1.13558	-1.38205	-1.3884	0.80865	.
95	9522	1.29453	1.60393	1.86392	1.7256	1.80713	.	0.02267
95	9523	0.53642	-0.25843	-0.50725	-0.10732	-0.31675	-0.50092	.
95	9524	0.56086	0.68784	0.77041	0.41996	1.16737	-0.80865	.
95	9525	-0.99718	-0.54238	-0.7121	-0.30763	-0.616	-0.07715	.
95	9526	3.16414	2.11032	2.24353	2.3386	2.45359	.	.
95	9527	0.49736	0.9163	1.03167	0.95822	1.02223	-0.37261	.
95	9529	3.92773	2.27393	2.58933	1.87166	2.73594	0.39637	.
95	9530	-1.01192	0.15713	0.33523	0.46566	0.21687	0	.
95	9531	-0.6437	0.31012	0.6087	0.12879	0.3801	.	.
95	9532	-0.48028	-1.40504	-1.38889	-1.12209	-1.33637	.	.
95	9533	0.12076	0.66555	0.79121	0.42047	0.54296	-0.77047	.
95	9534	-1.09496	-1.90284	-1.92657	-1.87152	-1.79458	0	.

Table B-2 Cont.

		Weaning Residuals					Steer Residual	First Calf Heifer Residual
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
95	9535	-0.59722	-0.89498	-1.00026	-0.89356	-1.01377	-0.50364	.
95	9536	2.31019	2.28242	2.03622	1.36865	1.72421	.	.
95	9537	1.21799	0.50466	0.82323	1.4229	0.76376	.	.
95	9538	-2.642	-1.53908	-1.78231	-1.15135	-2.14818	.	.
95	9539	2.02585	2.4624	2.61497	2.32006	2.61912	-0.18364	.
95	9540	-1.71445	-1.83647	-1.91632	-1.80965	-1.71534	.	.
95	9541	-1.06936	-0.90918	-1.08304	-1.52585	-1.37883	.	.
95	9542	-0.69044	-1.52712	-1.60853	-1.6398	-1.616	0.06609	.
95	9543	-0.53472	-0.40334	0.24839	0.41406	0.09497	0	.
95	9544	-0.86806	-0.73163	-0.54254	0.13525	-0.77124	.	.
95	9545	1.49406	1.05339	0.39317	0.02755	1.04648	.	.
95	9546	-0.86379	-0.49534	-0.66533	-0.33001	-0.76263	.	.
95	9547	-0.69774	0.5122	-0.0282	0.90057	0.59648	0	.
95	9548	-0.68087	-1.22939	-1.31431	-0.67409	-1.1479	0.32269	.
95	9549	-1.54103	-1.68995	-1.60659	-0.99339	-1.4847	.	.
95	9550	-0.92633	-1.23812	-1.05626	-1.21785	-1.49733	0.06987	.
95	9551	1.25989	0.99992	1.24516	1.46313	1.13955	-1.00056	.
95	9552	-0.06013	-0.36155	0.35549	-0.23908	-0.02614	0.86665	.
95	9553	0.84331	2.87103	2.79536	2.21303	2.61057	.	.
95	9554	-1.66456	-1.29205	-1.07881	-1.58397	-1.3543	.	.
95	9555	-2.21709	-2.46164	-2.38139	-1.83903	-2.44604	.	.
95	9556	-2.16013	-2.17382	-1.68937	-2.09235	-2.13365	.	.
95	9557	2.69913	2.70052	2.89064	2.50169	2.9486	.	.
95	9558	2.49177	2.25302	2.26182	1.95753	2.4269	.	.
95	9559	-0.98324	-0.26918	-1.03494	-0.16087	-1.01704	.	.
95	9560	-1.97416	-2.61742	-2.49047	-2.15294	-2.65352	.	.
95	9561	0.8738	0.79899	0.73063	0.83872	0.96964	.	.
95	9562	0.15708	-0.03721	0.1967	0.48634	0.15787	.	.
95	9563	-2.51251	-3.45845	-3.54992	-2.82563	-3.47746	.	.
95	9564	2.46512	2.66079	2.66535	2.17568	2.51691	.	.
95	9565	0.9743	0.8494	0.58276	0.31503	0.69939	.	.
95	9566	-1.55703	-1.60419	-1.20805	-0.97269	-1.33632	.	.
95	9567	-1.60866	-1.48346	-1.47182	-1.27189	-1.56202	.	.
95	9568	1.31044	1.79462	2.02949	1.36378	2.14251	.	.
95	9569	3.63166	2.96207	2.85481	2.38572	3.18451	.	.
95	9570	0.23122	-0.15993	-0.20367	-0.19477	-0.01573	.	.
96	9601	-0.62225	-2.20408	-1.85485	-1.67651	-1.9183	-0.54952	.
96	9602	0.03747	0.20405	0.00689	0.22328	0.38923	.	1.29059
96	9603	0.92124	1.8571	1.01006	1.39524	1.89519	0.58585	.
96	9604	0.67881	1.90751	1.82321	2.19895	1.34755	.	-0.70941
96	9605	0.14941	-0.27989	-0.65098	-1.04568	-0.50359	0.79423	.
96	9606	0.04079	-0.71072	-0.59537	-0.42998	-0.67425	-0.84357	.
96	9607	-0.5462	-1.33307	-0.8252	0.17652	-0.80123	-0.54414	.
96	9608	1.57012	2.74528	3.15022	2.5346	3.18486	.	0.29059
96	9609	-0.68754	-0.28654	-0.64151	-1.04915	-0.75955	.	.

Table B-2 Cont.

		Weaning Residuals					Steer Residual	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residual
96	9610	-0.4375	-1.42084	-1.15221	-0.65913	-1.63853	-0.25009	.
96	9611	0.43967	0.92746	0.79479	0.95938	0.61542	.	0.29059
96	9612	-1.58208	-2.97813	-2.63767	-2.9515	-3.04133	.	-0.70941
96	9613	1.37284	1.6852	1.72504	1.79948	1.62762	0	.
96	9614	-1.31975	-0.30483	-0.72898	-0.84894	-0.80361	0.185	.
96	9615	-0.60581	-0.53262	0.64822	-0.37472	-0.15624	.	-0.46092
96	9616	-1.24772	-1.41955	-1.49907	-1.10142	-1.29169	.	-0.64542
96	9617	1.96238	0.92174	1.10123	0.92229	1.43184	-0.7371	.
96	9618	1.14089	1.73541	1.62627	1.26685	1.55332	-0.47663	.
96	9619	-0.46019	-0.51071	-0.74428	-0.95377	-0.786	.	-0.46092
96	9620	-1.2027	-1.17657	-1.97315	-1.29265	-1.54283	.	-0.46092
96	9621	-0.6897	-0.48704	-0.84496	0.11182	-0.63061	.	.
96	9622	-2.00955	-2.91103	-2.74784	-2.6186	-2.32826	0.29406	.
96	9623	-0.52985	-0.43815	0.04781	0.00246	-0.65962	-0.29406	.
96	9624	-1.29959	-1.32053	-1.09452	-0.71058	-1.17942	.	-0.46092
96	9625	-3.03191	-1.9798	-1.833	-2.33403	-2.45531	0.07715	.
96	9626	0.36682	0.88471	0.65923	0.54742	1.12166	-0.56715	.
96	9627	-0.40671	-1.61759	-1.60019	-1.62876	-1.5642	.	-0.94547
96	9628	-0.42244	0.67536	1.22769	1.08446	1.12843	.	0.05453
96	9629	2.21387	0.82966	1.02724	1.05417	0.94295	.	.
96	9630	-1.88257	-0.40584	-0.39577	-0.79454	-0.98942	.	-0.94547
96	9631	0.20394	1.30758	1.07725	1.92219	1.50212	.	.
96	9632	1.09891	1.33388	0.84516	1.06309	1.20344	0.88535	.
96	9633	0.19718	-0.06825	-0.1427	0.44746	0.02489	.	.
96	9634	0.49459	0.82209	0.6902	0.81468	0.7405	.	.
96	9635	-0.72949	-0.56855	-0.90192	-0.40456	-0.92624	.	.
96	9636	-2.58828	-3.37436	-3.39999	-3.16854	-3.38062	.	-0.94547
96	9637	0.47148	0.114	0.16688	-0.07112	0.06725	.	.
96	9638	0.65207	2.99553	3.32338	3.31762	2.94141	0	.
96	9639	-1.66257	-0.64378	-0.52573	-0.89452	-0.43779	.	-0.94547
96	9640	1.29531	2.52478	2.844	2.01157	2.60281	.	.
96	9641	-0.04075	-1.40657	-0.97289	-1.02818	-0.85128	.	0.05453
96	9642	2.87948	2.61101	3.21504	2.52087	3.19146	.	-0.94547
96	9643	-1.14139	0.06107	-0.02625	-0.98791	-0.40487	.	.
96	9644	-1.44096	-2.08492	-2.28138	-1.55791	-1.92872	.	.
96	9645	1.04583	1.07483	1.35977	0.09697	0.92855	.	.
96	9646	3.03757	2.46156	2.26247	2.21075	2.56109	.	.
96	9647	-0.88556	-1.30109	-1.5017	-1.36664	-1.02235	.	.
96	9648	-0.51624	-1.25766	-1.48695	-1.62815	-1.39318	0	.
96	9649	-1.89226	-3.63304	-3.52436	-3.74354	-3.38111	.	.
96	9650	1.92322	3.06203	2.92187	2.82974	2.98327	-0.42012	.
96	9651	-1.41138	-2.70396	-2.97209	-2.46874	-2.68414	.	.
96	9652	0.70104	0.86012	1.04948	0.91317	0.57839	.	1.05453
96	9653	0.52106	0.98503	1.56786	2.18831	1.57616	.	.
96	9654	0.48508	1.01742	0.92958	2.02427	1.40283	.	3.05453

Table B-2 Cont.

		Weaning Residuals					Steer Residual	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residual
96	9655	-0.33105	-0.05572	0.46964	-0.14391	0.07605	.	.
96	9656	1.83063	1.79791	1.99384	2.23068	2.09439	.	.
96	9657	0.56074	-0.11477	-0.24197	0.16299	-0.06948	.	0.05453
96	9658	3.489	2.55468	2.59413	2.64909	2.69867	.	.
96	9659	1.35532	2.60807	2.82477	2.5544	2.57717	.	.
96	9660	-1.93426	-2.98084	-2.92794	-2.87177	-2.70252	.	.
96	9661	1.74388	2.8819	2.33975	2.52614	2.29511	.	.
96	9662	-0.81939	-2.13426	-2.17858	-1.95349	-2.11628	.	-0.94547
96	9663	-0.80643	0.6213	0.43106	0.51593	0.33659	.	.
96	9664	-1.67359	-2.14264	-2.64591	-2.63112	-2.50735	.	-0.44547
96	9665	1.26913	0.67472	0.55968	0.38537	0.72728	.	1.05453
96	9666	1.61219	1.19603	1.01618	1.01414	0.9146	.	0.05453
96	9667	0.37045	0.3093	0.61349	0.40036	0.53207	.	.
96	9668	-1.92157	-3.38053	-3.0242	-2.65991	-3.14534	.	.
96	9669	2.30441	0.65315	0.83505	0.5606	1.09235	.	0.05453
96	9670	1.05611	3.149	3.0079	3.08064	2.63629	.	0.05453
96	9671	-1.31165	-0.60133	-1.27318	-0.99591	-0.89057	.	.
96	9672	-1.46231	-0.99344	-1.89885	-1.53654	-2.00372	.	1.05453
96	9673	-1.31268	-2.14364	-2.51247	-1.91218	-2.48883	.	.
96	9674	-0.62299	-0.12034	0.13142	-0.37737	-0.0616	0.38384	.
96	9675	-0.15329	-0.18428	-0.04973	0.15711	0.09901	.	1.05453
96	9676	-1.11908	-1.32096	-0.77511	-1.4445	-1.35044	0	.
96	9677	0.10728	-0.05169	-0.10145	-0.02146	-0.06335	.	0.55453
96	9678	0.43569	0.16095	0.33165	-0.06103	-0.02911	.	.
96	9679	-1.60727	-2.26178	-1.75005	-2.34043	-1.8137	.	.
96	9680	-2.03257	-2.06579	-1.70207	-2.3307	-2.31349	.	.
96	9681	1.0747	1.1245	0.63289	0.44097	0.61427	.	.
96	9682	-1.12587	-0.27199	-0.02983	0.15344	-0.31074	0.46324	.
96	9683	0.88192	0.33295	0.2767	0.21001	0.89543	.	.
96	9684	-0.34921	-1.07409	-0.65029	-0.31278	-0.13325	0.13225	.
96	9685	0.60446	0.61584	0.60251	0.4319	0.83984	.	.
96	9686	1.92962	2.37413	2.55543	1.9975	2.29684	0	.
96	9687	-2.34696	-2.63281	-2.76737	-2.01677	-2.88024	.	.
96	9688	-1.12467	-1.52073	-1.52743	-0.9183	-1.42445	0.24505	.
96	9689	0.12904	1.83883	0.70713	1.50644	1.09182	.	.
96	9690	-0.08168	0.34667	-0.00863	0.62343	0.1271	.	.
96	9691	1.05856	2.10758	2.49417	2.51748	2.1075	.	.
96	9692	-0.89496	-1.68954	-1.56838	-1.72035	-1.43611	.	.
96	9693	-0.16257	-1.05806	-1.54913	-1.24771	-1.17075	0.50364	.
96	9694	0.43724	0.79439	0.29267	0.73462	0.72394	-0.34306	.
96	9695	-0.35865	0.02794	-0.08593	-0.46759	-0.16593	.	.
96	9696	1.66397	1.09854	1.54173	0.66376	1.54098	.	.
96	9697	1.75446	0.97167	0.56986	0.17668	0.8529	0.10306	.
96	9698	3.41562	2.33814	2.16068	1.56624	2.42743	-0.00824	.
96	9699	0.95653	0.60715	1.03358	-0.11032	0.76459	0.41175	.

Table B-2 Cont.

		Weaning Residuals					Steer Residual	First Calf Heifer Residual
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	
96	96100	-0.38202	-0.24476	-0.09757	-0.50721	-0.4289	-0.2942	.
96	96101	-0.56204	-0.85484	-1.25557	-1.20524	-1.20918	0.09802	-0.70927
96	96102	-1.27532	-1.66698	-1.11233	-0.7821	-1.40034	0	.
96	96103	0.21775	0.93561	1.30055	0.77554	0.74289	-0.46324	.
96	96104	0.07201	0.63054	0.3303	0.69414	0.3738	0.02357	.
96	96105	-1.33858	-1.11075	-1.33229	-1.25172	-1.23717	-0.06987	.
96	96106	0.20203	0.10714	0.26787	0.66357	0.39198	.	1.29073
96	96107	-1.26616	-1.8055	-1.68777	-1.5982	-1.55259	.	.
96	96108	0.29261	1.03756	1.76717	0.92588	1.26338	.	-0.19382
96	96109	-0.09212	-0.68186	-0.93829	-0.27207	-0.3692	0	-1.19382
96	96110	1.53348	0.80476	0.88535	0.46285	0.81757	.	0.80618
96	96111	2.29438	2.57312	1.32017	1.68606	2.3294	.	.
96	96112	-1.90193	-2.07072	-2.09976	-1.95121	-2.34347	.	.
96	96113	-1.35985	-1.78744	-1.71828	-1.62385	-2.27933	0.26265	.
96	96114	0.1009	1.07571	1.18836	0.79314	0.84734	.	.
96	96115	-0.67802	-1.05793	-0.60714	-0.32125	-0.32417	0.03592	.
96	96116	-0.43584	-0.46079	-0.80385	0.45842	-0.1144	0.61168	.
96	96117	0.83096	1.5637	1.96517	0.35126	1.4118	-0.23531	.
96	96118	1.95984	2.16614	2.28672	2.17501	2.16948	.	.
96	96119	0.8406	2.39076	2.11007	2.70027	2.12085	.	.
96	96120	-0.1491	-0.17429	-0.06164	-0.20686	0.09734	.	.
97	9701	-0.45129	0.90978	0.4775	0.88328	0.83946	1.83597	.
97	9702	-0.49776	-1.25336	-1.0929	-0.88816	-0.94306	.	.
97	9703	-0.03759	0.06812	0.25548	0.79297	0.24856	-0.30262	.
97	9704	1.21521	0.70218	0.84445	0.22391	0.88895	0	.
97	9705	0.78302	0.40978	1.43458	0.29785	0.83358	-1.44964	.
97	9706	1.2215	0.84754	1.34293	1.08012	1.13485	0	.
97	9707	3.77199	2.85186	3.08934	2.64379	3.28978	.	.
97	9708	-0.27018	-0.70677	-0.99417	-0.7404	-0.67191	0.06495	.
97	9709	-0.70131	-0.4651	-0.62813	-1.05699	-0.58599	.	.
97	9710	-0.93347	-1.07504	-1.11519	-1.09459	-1.27076	.	.
97	9711	-0.35338	0.45278	0.39805	0.77456	0.39874	.	.
97	9712	-0.82024	0.09519	-0.35158	-0.59256	-0.32924	-0.40592	.
97	9713	3.23229	2.85497	3.22644	3.36754	3.43931	0.92104	.
97	9714	-1.52938	-0.91605	-0.64546	-0.60924	-1.1899	-1.03676	.
97	9715	-1.52615	-1.95426	-1.56919	-1.92053	-2.07126	0.38663	.
97	9716	0.73691	-0.1502	-0.32686	-0.03668	-0.21692	0	.
97	9717	-0.09748	1.01935	0.59434	0.91856	0.6612	-0.47943	.
97	9718	-3.23007	-0.19712	-0.43765	-0.24179	-0.99707	1.03676	.
97	9719	-2.14752	-2.31444	-2.9646	-2.12959	-2.57243	0.37261	.
97	9720	1.45019	-0.16043	0.12648	-0.2259	0.36543	0	.
97	9721	-1.32698	-3.09599	-3.31122	-3.13387	-3.05065	0.17078	.
97	9722	-1.96568	-0.92242	-0.59116	-0.58179	-1.06906	.	.
97	9723	2.21698	1.47109	1.75707	0.90468	1.74088	.	.
97	9724	-0.42027	0.15774	0.56972	0.39038	0.48193	.	.

Table B-2 Cont.

		Weaning Residuals					Steer Residual	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residual
97	9725	-0.79305	-0.32281	-1.0802	-0.62359	-1.18019	.	.
97	9726	1.4899	1.08319	1.19694	1.0747	1.19482	0.0157	.
97	9727	-0.51111	0.60519	0.3826	0.58687	0.59832	0	.
97	9728	1.50408	0.63137	0.58262	0.47614	0.90424	.	.
97	9729	2.22902	2.22823	1.7754	1.3637	1.8972	0.64195	.
97	9730	1.78688	0.41193	0.68361	0.54045	0.65419	-0.27835	.
97	9731	0.53138	0.78811	1.07237	0.84075	1.05764	.	.
97	9732	-1.35906	-0.98111	-1.06244	-0.64179	-1.16334	.	.
97	9733	0.42314	0.01733	0.01474	0.00684	0.30825	-0.63526	.
97	9734	-2.62008	-1.75751	-1.75477	-1.50623	-1.96475	-0.85842	.
97	9735	-2.03207	-2.72422	-2.67224	-2.28962	-2.89623	.	.
97	9736	-2.64962	-3.32899	-3.18688	-3.49809	-3.24611	.	.
97	9737	-1.38172	-1.18991	-1.14662	-0.99763	-1.65398	.	.
97	9738	-0.92876	-1.27983	-1.42336	-0.80636	-1.24175	.	-0.67792
97	9739	2.38947	1.23857	1.26729	0.5933	1.52167	.	-1.17792
97	9740	1.04164	1.63576	1.69217	1.48443	1.5302	.	.
97	9741	-0.92008	-0.78094	-0.95606	-0.67032	-0.97792	.	2.82208
97	9742	-2.00254	-1.42407	-1.31053	-1.25392	-1.32067	.	-1.17792
97	9743	2.49363	2.0434	2.00921	1.4456	2.19353	.	.
97	9744	1.0562	1.36118	1.56041	1.26356	1.40302	.	.
97	9745	-0.99679	-0.71301	-0.82495	0.23431	-0.8758	.	.
97	9746	0.65115	1.33607	1.39168	0.94397	1.32093	.	0.07057
97	9747	2.51082	1.35411	1.16004	0.79676	1.64602	.	0.07057
97	9748	0.40705	0.54482	0.60119	0.68381	0.6628	.	0.07057
97	9749	-1.91262	-0.82089	-0.96423	-0.58125	-1.20498	.	.
97	9750	-0.98754	-0.5194	-0.49189	-0.53629	-0.24201	.	.
97	9751	2.39539	2.01853	1.67832	2.10137	1.93615	.	.
97	9752	-0.1194	-0.32661	-0.43909	-0.20689	-0.48874	.	.
97	9753	2.1392	1.89875	1.89827	1.60177	1.8026	.	.
97	9754	-0.31324	-0.61134	-0.53358	-0.48471	-0.51213	.	.
97	9755	-1.29817	-0.64253	-0.81642	-0.46904	-0.56014	.	.
97	9756	-0.54245	-0.40255	-0.39184	-0.49814	-0.45728	.	.
98	9801	-0.44329	-1.03055	-1.24458	-1.80262	-1.30287	-1.20481	.
98	9802	-0.06284	-0.21273	0.36086	-0.4774	0.01657	-0.44288	.
98	9803	-0.42069	-0.40551	-1.16883	-0.94618	-0.69074	.	-0.67792
98	9804	-1.40983	-2.13557	-1.94725	-1.68575	-2.17288	.	-1.17792
98	9805	0.80667	0.35375	0.51612	0.30736	0.82612	0.61897	.
98	9806	2.10102	2.38437	3.27433	2.07467	2.84498	.	2.82208
98	9807	-0.75768	0.97214	0.60135	0.66032	0.18228	.	-1.17792
98	9810	-0.63789	-0.8342	-0.90404	-0.44256	-0.69138	0	.
98	9811	0.54098	0.17636	0.36489	0.40525	0.42187	.	0.07057
98	9812	-1.86213	-2.42969	-2.26374	-2.17682	-2.19154	.	0.07057
98	9813	1.80832	1.4379	1.13927	1.66851	1.60603	.	0.07057
98	9814	2.13544	1.33613	1.18569	1.29796	1.53422	0.7371	.
98	9815	-0.18813	1.31483	1.09719	1.63486	0.95033	.	.

Table B-2 Cont.

		Weaning Residuals					Steer Residual	First Calf Heifer
Family	Calf ID	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall	Overall	Residual
98	9816	-1.36233	-1.71853	-1.48313	-1.41808	-1.61079	0	.
98	9817	-0.24762	0.79131	0.47188	0.90047	0.2778	0.29163	.

APPENDIX C

STANDARD DEVIATIONS FOR RESIDUALS FOR WEANED CALVES, STEERS SHORTLY BEFORE SLAUGHTER AND HEIFERS

Table C-1. Standard deviations (SD) for residuals of 4 component traits and overall disposition at weaning, overall disposition shortly before slaughter, and disposition in first calf heifers by family

	Weaning						
Family	Aggressiveness	Nervousness	Flightiness	Gregariousness	Overall Disposition	Steers Shortly Before Slaughter	First Calf Heifer
70	1.238	1.493	1.647	1.536	1.492	0.588	1.326
71	1.134	1.375	1.316	1.130	1.312	0.577	1.286
72	1.282	1.279	1.218	1.078	1.302	0.591	0.944
73	1.414	1.216	1.420	1.107	1.340	0.693	0
74	1.748	0.687	0.818	0.787	1.104	0.363	1.041
75	1.109	1.397	1.433	1.356	1.375	0.765	1.182
76	0.963	1.187	1.253	1.316	1.253	1.213	0.752
77	1.518	1.714	1.754	1.593	1.790	0.713	1.187
80	1.101	1.285	1.350	1.302	1.304	0.875	1.057
81	1.546	1.471	1.512	1.326	1.503	0.711	1.225
82	1.232	1.428	1.353	1.239	1.368	0.576	0
83	1.635	1.930	1.965	1.691	1.964	1.086	0.915
84	1.100	1.360	1.412	1.252	1.335	0.687	1.130
95	1.509	1.540	1.533	1.382	1.574	0.589	1.043
96	1.325	1.628	1.637	1.556	1.627	0.406	0.922
97	1.621	1.390	1.449	1.292	1.504	0.721	1.367
98	1.252	1.424	1.478	1.392	1.456	0.666	1.367

APPENDIX D

SIGNIFICANCE OF FIXED EFFECTS FOR WEANED CALVES, STEERS SHORTLY BEFORE SLAUGHTER, STEERS AT SLAUGHTER AND FIRST CALF HEIFERS

Table D-1. *P*-values of fixed effects for weaned calves, steers shortly before slaughter, steers at slaughter and first calf heifers

Dependant Variable[a]	Sire	Family (Sire)	BYS[b]	Pen (BYS)	Gender	Evaluator (BYS)	G x S[c]	FP[d] (BYS)	Slorder[e] (Sldate[f] (BYS))	Knock	CYS[g] (BYS)
WEANET											
Agres	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	—	—
Nerv	0.009	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	—	—
Flight	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	—	—	—	—
Greg	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	—	—	—	—
Overall	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	—	—
WEAN											
Agres	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	—	—	—	—
Nerv	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.014	—	—	—	—
Flight	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.014	—	—	—	—
Greg	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.026	—	—	—	—
Overall	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.006	—	—	—	—
YEARET											
Agres	0.346	0.014	0.737	—	—	—	—	0.646	—	—	—
Nerv	0.013	0.006	0.298	—	—	—	—	0.252	—	—	—
Flight	0.019	0.001	0.242	—	—	—	—	0.186	—	—	—
Greg	0.084	0.002	0.707	—	—	—	—	0.391	—	—	—
Overall	0.054	0.018	0.166	—	—	—	—	0.517	—	—	—
YEAR											
Agres	0.151	0.012	0.256	—	—	—	—	0.103	—	—	—
Nerv	0.001	0.001	0.001	—	—	—	—	0.017	—	—	—
Flight	0.001	< 0.001	0.001	—	—	—	—	0.012	—	—	—
Greg	0.054	0.001	< 0.001	—	—	—	—	0.153	—	—	—
Overall	0.020	0.010	0.001	—	—	—	—	0.100	—	—	—

Table D-1 Cont.

Dependant Variable[a]	Sire	Family (Sire)	BYS[b]	Pen (BYS)	Gender	Evaluator (BYS)	G x S[c]	FP[d] (BYS)	Slorder[e] (Sldate[f] (BYS))	Knock	CYS[g] (BYS)
SLET											
KClass	0.038	0.300	0.578	—	—	—	—	—	0.027	0.004	—
KCont	0.067	0.228	0.697	—	—	—	—	—	0.017	—	—
None	0.094	0.113	0.797	—	—	—	—	—	0.026	—	—
SL											
KClass	0.288	0.310	0.723	—	—	—	—	—	0.010	< 0.001	—
KCont	0.352	0.329	0.680	—	—	—	—	—	0.013	—	—
None	0.314	0.305	0.632	—	—	—	—	—	0.006	—	—
FCHET											
Jdate	0.035	0.088	0.742	—	—	—	—	—	—	—	0.327
NoJdate	0.036	0.077	0.749	—	—	—	—	—	—	—	0.298
FCH											
Jdate	0.122	0.028	0.542	—	—	—	—	—	—	—	0.037
NoJdate	0.058	0.050	0.338	—	—	—	—	—	—	—	0.270

[a] WEANET = ET weaned calves; WEAN = weaned calves; Agres = aggressiveness score; Nerv = nervousness score; Flight = flightiness score; Greg = gregariousness score; Overall = overall disposition; YEARET = ET steers shortly before slaughter; YEAR = steers shortly before slaughter; SLET = ET steers at slaughter; SL = steers at slaughter; KClass = knock as class variable; KCont = knock as continuous variable; None = knock not included; FCHET = ET first calf heifers; FCH = first calf heifers; Jdate = Julian calving date included; NoJdate = Julian calving date not included

[b] BYS = Birth year and season

[c] G x S = Gender by sire interaction

[d] FP = Feeding pen

[e] Slorder = Slaughter order

[f] Sldate = Slaughter date

[g] CYS = Calving year and season

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